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PALÆONTOLOGY.

ON THE DERMAL COVERING OF A MOSASAURIOID REPTILE.

(*Liodon dyspelor* Cope).

BY PROF. F. H. SNOW, OF THE UNIVERSITY OF KANSAS.

The geological section of the Kansas University scientific expedition for 1878, in charge of Professor B. F. Mudge and the writer, examined with care a portion of the blue-gray shales and the yellow limestones along the Hackberry creek, in Gove county, Kansas. These rocks belong to the Niobrara group of the cretaceous formation. The locality had been previously visited by several parties of geological explorers, who had obtained from it many valuable fossils, and it was hardly expected that the gleanings from a field so thoroughly worked would contain anything of unusual value. But the frosts and rains of a single year had exposed to view many remains of fishes and saurians, and our labors were unexpectedly and abundantly rewarded. In less than three weeks, 41 saurians, 117 fishes and 6 pterodactyls (Pteranodonts), were discovered, many of them in almost perfect condition, and all of them of sufficient value to justify their transportation for a distance of 300 miles, to take their places in the cabinets of the University.

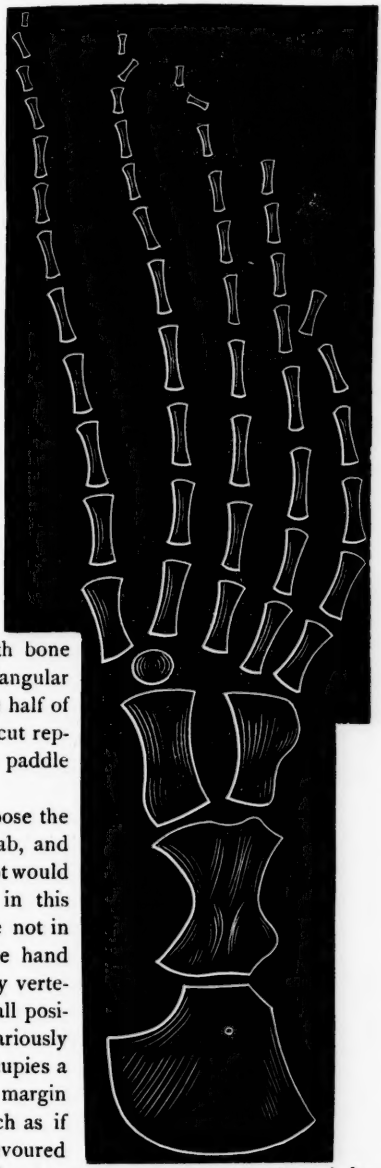
The most valuable specimen was a saurian, found in the yellow limestone by the writer. A single vertebral bone was first observed, on June 17th, upon the blue shale at the bottom of a narrow ravine. No further remains were discovered until the following day, when a systematic search was made, in company

with my assistant, Mr. L. L. Dyche. We soon detected a second bone, this time one of the phalanges, lying loosely upon the side of the ravine, several feet above the first bone and a little farther up the ravine. In a few moments more the head of a vertebra was obscurely seen in the face of the solid yellow limestone, about 8 feet from the top of the ravine. An hour's work sufficed to detach a block of rock containing several vertebræ and other bones. While removing the superfluous material from this block, in order to facilitate its removal to camp, a fortunate stroke of the hatchet revealed a peculiar reticulated surface, several square inches in extent. The thought instantly flashed upon my mind that here was something which had never before been seen by human eye. The conclusion was irresistible that the reticulated surface was the fossilized covering of the skin of the saurian, so perfectly preserved that every scale was distinctly visible, its outline clearly marked, and the elevated central line, or "carina," unmistakably indicated. Although, according to Prof. Dana's time-ratios, a period of five million years must have elapsed since this saurian swam in the shallow waters of the cretaceous seas of Western Kansas, yet each individual scale exposed to view was as perfectly preserved as if the animal had but yesterday died.

Prof. Marsh, of Yale college, some years ago described the large dermal plates, or scutes, belonging to other mosasauroid genera, which, as he writes me, "appear to be mainly confined to the neck and throat." But, so far as I am able to learn, nothing has been hitherto known of the *general* covering of the saurian body in *any* genus, and nothing whatever of the dermal covering in the genus *Liodon*. It might have been expected that this covering would be found to consist of larger plates, like those of the alligator and crocodile. On the contrary, it is composed of small scales, much resembling in size, shape and arrangement, the scales of living Ophidians. Dana, in his Manual of Geology (2d Edition, p. 465), speaks of the mosasaurs as "snake-like reptiles." This comparison is strengthened when it is found that their dermal scales were almost an exact prefiguration of those of the rattle-snakes which infest the ledges within which these saurians are found. The scales first exposed to view appeared to be on the anterior portion of the central surface of the body, but another small area was found not far from the pelvic bones. All the scales discovered were on the lower surface of the body, the bones lying above them, except in one or two spots where a bone had, by pressure, been forced through the dermal covering. The original surface exposed was afterward increased in extent, until a total continuous area of 33⅓ square inches was uncovered. This surface contained an average of 90 scales to the square inch, or a total of 3,000 scales. These are all preserved upon a single block of limestone, which also contains several vertebræ, phalanges, and other bones. A comparison with the scales of the living rattlesnake of the plains (*Crotalus confluentus* Say), indicates that the scales of the saurian were somewhat smaller than those of the snake, which, in a full grown "rattler," average 80 to the square inch, instead of 90.

On the day after the discovery of this dermal surface, I determined to obtain the remainder of the saurian, which was imbedded in the solid rock. It was

necessary to remove 8 feet of superincumbent material before the proper level or "horizon" was reached, and also to undermine the specimen, in order to secure the remains in their original position, and, if possible, to expose a larger portion of the dermal covering. After three days and a half of hard labor, by myself and two assistants, we succeeded in removing one large slab, 5½ feet by 2½ feet, and 6 inches in thickness, weighing 500 lb., and two smaller slabs, each containing the bones of a hind leg and foot. The large slab was found to contain dorsal vertebræ, ribs, and pelvic bones, in perfect preservation, and apparently without distortion. It also contains one of the forward limbs, or hands, lying underneath the ribs and vertebræ, with the bones in natural position. In this hand there are 47 of the hour-glass shaped bones of the palm and fingers, the five series consisting respectively of 12, 11, 10, 8, and 6 bones. The terminal or 12th bone of the first series is very minute, and triangular in shape, or, more exactly, shaped like the half of an hour-glass. The accompanying wood cut represents the bones of this hand or front paddle precisely as they lie in the slab.



No attempt has yet been made to expose the dermal covering contained in the large slab, and it is exceedingly doubtful if such an attempt would prove successful. The bones imbedded in this slab, and now brought out in relief, are not in their natural position, except those of the hand above mentioned. Only two of the twenty vertebræ, which are scattered over the slab in all positions, remain united. The dozen ribs are variously disposed, and one of the thigh bones occupies a spot not far from the center of the lower margin of the slab. The appearance is very much as if some more powerful saurian or shark had devoured the flesh upon the larger bones of the victim, leaving untouched a portion of the skin of the lower surface of the body and one of the front paddles, which proba-

bly did not contain much material for the gratification of his appetite.

In regard to the generic determination of this saurian, I can only say, that of the three well marked genera of the mosasauroid reptiles of the Kansas cretaceous, the specimen seems to agree most accurately with *Liodon* Owen (*Tylosaurus* Marsh). This genus is indicated by the broad neural spines, and by the fact that the number of bones in the first digit of the paddles is the greatest. The specific determination given in the title of this paper will probably be found to be correct. The specimen appears to be a small-sized individual of its species.

The following measurements are appended:

	M.
Dermal scale—	
Length	.0033
Breadth	.0025
Length of "carina,"	.0037
Dorsal vertebra—	
Length of centrum	.075
" neural spine	.095
Breadth of neural spine, at base	.074
" " " at tip	.039
Vertical diameter of cup	.058
Transverse diameter of cup	.000
Longest rib—	
Tip to tip	.381
Along curvature	.418
Breadth at base	.025
" tip	.009
" center	.012
Femur—	
Length	.132
Breadth at proximal end	.082
" distal end	.073
" center	.050
Front paddle, total length	.726
Coracoid—	
Length	.118
Breadth at proximal end	.131
Curvature at proximal end	.195
Breadth at distal end	.056
Distance of perforation from outer edge	.026
" " inner edge	.042
Humerus—	
Length	·122
Breadth at proximal end	·074
" distal end	·080
Ulna—	
Length	.093
Breadth proximal	.041
" distal	.063
Radius—	
Length	.094
Breadth proximal	.047
Breadth distal	.041

ARCHÆOLOGY.

PERUVIAN ANTIQUITIES.

BY E. R. HEATH, M. D., WYANDOTTE, KAS.

On the Peruvian coast in ancient times, as now, nearly every structure was made of adobes or sun-dried brick, while in the mountains stone was used instead. The adobe ruins present nothing of beauty, architecturally. The subject for wonder is their immensity and number. Go where you will, relics of the past meet your eye either in ruined walls, water-courses, terraces, or extensive lands covered with the debris of pottery.

Take for example the Jequetepeque valley. In 7° 24′ south latitude you will find on recent maps the port of Pacasmayo. Four miles north, separated from it by a barren waste, the river Jequetepeque empties into the sea. The bottom lands of the river are from two to three miles in width, with a southern sloping bank and the northern a perpendicular one nearly eighty feet high. Beside the southern shore, as it empties into the sea, is an elevated plat one-fourth of a mile square and forty feet high, all of adobes. A wall fifty feet wide connects it with another, a few hundred yards east and south, that is 150 feet high, 200 feet across the top, and 500 at the base, nearly square. This latter was built in sections of rooms ten feet square at the base, six feet at the top and about eight feet high. These rooms were afterward filled with adobes, then plastered on the outside with mud and washed in colors. All of this same class of mounds—temples, to worship the sun, or fortresses, as they may be—have on the north side an incline for an entrance or means of access. Treasure-seekers have cut into this one about half way, and it is said $150,000 worth of gold and silver ornaments were found. In the sand, banked up behind the wall and mound, many were buried, as the thousands of skulls and bones now exposed prove; thrown out by the hunter of huacos, as the pottery is called, huaca being the name given to these cemeteries. Each body has buried with it a vessel or water craft and a pot with grains of corn or wheat, and it is supposed the drinking vessel was filled with "chicha," a fermented drink made from corn or peanuts. Beside these were many ornaments of gold, silver, copper, coral and shell beads and cloths. On the north side of the river, on the top of the bluff, are the extensive ruins of a walled city, two miles wide by six long. Within the enclosure are the relics of two large reservoirs for fresh water. The clay from which these adobes were made was found at least six miles distant.

Follow the river to the mountains. All along you pass ruin after ruin and huaca after huaca. At Tolon, a town at the base of the mountains, the valley is crossed by walls of boulders and cobble stones, ten, eight and six feet high, one foot to eighteen inches wide at the top and two to three feet at the base, enclos-

ing ruins of a city one-fourth of a mile wide and more than a mile long. The upper wall has projecting parts at the entrances, with port-holes, evidently serving as sentry boxes. At this point the Pacasmayo Railroad enters the Jequetepeque valley. For eight miles back it crosses a barren sand plain of more than fifteen miles in length, covered with ruined walls, water courses, dead algaroba and espino trees, with fragments of pottery and sea shells, even to nine feet in depth mixed with the sand. The base of the mountains have, in good state of preservation, many thousand feet of an old water course, while their sides to the perpendicular parts are lined with terraces. This water course took its head from a ravine now dry, and, even beyond the memory of the oldest inhabitants, except in one or two cases, never carried water. It can be traced as far as Ascope, forty-five miles south. Five miles from Tolon, up the river, there is an isolated boulder of granite, four and six feet in its diameters, covered with hieroglyphics. Fourteen miles further, a point of mountain at the junction of two ravines is covered to a height of more than fifty feet with the same class of hieroglyphics: Birds, fishes, snakes, cats, monkeys, men, sun, moon and many odd and now unintelligible forms. The rock on which these are cut is a silicated sandstone, and many of the lines are an eighth of an inch deep. In one large stone there are three holes, twenty to thirty inches deep, six inches in diameter at the orifice and two at the apex, and although polished as porcelain, these markings extend even to the bottom. The locality is of no importance; the stones as nature placed them; why, then, was so much labor and time expended upon them?

At Anchi, on the Rimac river, upon the face of a perpendicular wall two hundred feet above the river bed, there are two hieroglyphics, representing an imperfect B and a perfect D. In a crevice below them, near the river, were found buried twenty-five thousand dollars worth of gold and silver. When the Incas learned of the murder of their chief, what did they do with the gold they were bringing for his ransom? Rumor says they buried it, and many places are pointed out and thousands of dollars spent in useless search for the lost treasure. May not these markings at Yonan tell something, since they are on the road and near to the Incal city? Eleven miles beyond Yonan, on a ridge of mountain seven hundred feet above the river, are the walls of a city of 2,000 inhabitants. A perilous ascent on hands and knees is now the only way to reach it; however, on the opposite side of the river are similar ruins, but easy of access. A remnant of a stone wall, ten and twelve feet high, built of small flat stones and without mortar, probably at one time served as river protection and against the tribe on the other side, there being a tradition that two powerful chiefs occupied these cities and were ever at war. The dead were buried in sepulchres, using large boulders as the top, while stone walls divided the space beneath into compartments. Six and twelve miles further are extensive walls and terraces. Three miles north of the latter place are the rich silver mines of Chilete, formerly worked by the Indians, who left excavations two and three

hundred feet deep, and must have taken out quantities of silver. A company with a paid-up capital of half a million is now working them.

Leaving the valley at seventy-eight miles from the coast, you zigzag up the mountain side 7,000 feet, then descend 2,000, to arrive at Cajamarca, or Coxamalca of Pizarro's time. Here and there all the way you find relics of the past. In a yard off one of the main streets, and near the center of the city, is still standing the house made famous as the prison of Atahualpa, and which he promised to fill with gold as high as he could reach, in exchange for his liberty. Like all their stone work, the walls are slightly inclined inward, uncemented, built of irregular stones, each exactly faced to fit the next. The floor and porch are cut out of the solid stone, two and three feet deep, as the still intact remnants of stone pillars of the same rock show. The hill from which the stone for the walls was taken is near by. On its top a large stone in the shape of a chair bears the name of "Inca's chair," and the Indians say it was the king's custom to sit here every morning and salute the sun as it rose above the horizon. The two large places excavated out of the rock on the hillside, and now used as reservoirs for the city, were of ancient make. Three miles distant, and across the valley, are the hot springs, where the Inca was encamped when Pizarro took possession of Cajamarca. Part of the wall is of unknown make, (that encloses the baths.) Cemented, the cement is harder than the stone itself. At Chocofan, nine miles from Pascamayo, on the line of the railroad, a barren, rocky mountain, 1,200 feet high, is encircled four hundred feet from its top by a stone wall eight or ten feet high. From its northern side, running nearly northwest, is about five miles of the coast road of the Incas. Perfectly straight, it is twenty feet wide, and walled on both sides by round stones piled to a height of three and four feet, three feet wide at the base and two at the top, uncemented. At Chepen, a station near the terminus of the branch of the Pacasmayo Railroad, is a mountain with a wall in many places twenty feet high, the summit being almost entirely artificial. In the sand at its base is one of Peru's most extensive "huacas," and from which some of the finest pottery and ornaments have been taken.

Fifty miles south of Pacasmayo, between the seaport of Huanchaco and Truxillo, nine miles distant, are the ruins of "Chan Chan," the capital city of the Chimoa kingdom, which extended, when conquered by the Incas, from Supe to Tumbez, or over nearly the northern half of the coast of modern Peru. The road from the port to the city crosses these ruins, entering by a causeway about four feet from the ground, and leading from one great mass of ruins to another; beneath this is a tunnel. Be they forts, castles, palaces, or burial mounds called "huacas," all bear the name "huaca." Hours of wandering on horseback among these ruins give only a confused idea of them, nor can old explorers there point out what were palaces and what were not.

To the right is the "Huaca of Toledo;" to the left, "Bishop's Huaca." The large square enclosures, shut in by wedge-shaped walls of adobe, twenty to twenty-five feet high, have nothing of an entrance into them that would be defined as a palace gate. A half a dozen of these, at least, are among the ruins. Within

some of them are large square mounds or burying chambers, many of which have been opened and rifled of their contents. These are plastered at the ceilings. Beside the so-called "huacas" already mentioned, there is another on the left side of the road called by the Spaniards "the Mass." On many of the walls is some excellent stucco work. Excellent as regards the material of which it is made, more than with reference to its style of art. There is not a single grain of disintegration in the parts that surround the walls of the chamber, although it is half an inch high above the ordinary plaster in which it is done, nor the slightest impairment in its integrity during the many centuries it has stood exposed to the elements. The highest enclosures—those of adobe brick, up to thirty feet, with a base of fiteen feet, on the right hand of the city as you advance toward Truxillo, between that town and the "Toledo huaca"—must have cost an immense amount of labor, and needed a large number of hands for their erection. Inside some of them, besides the square mounds, are narrow passages, not more than a yard in width. In others are squares, wherein are visible, though now filled with clay, the outlines of water tracks. On this side are the principal burial mounds, some having stairs of adobe.

In the city of Truxillo there exists in the records of the municipality a copy of the accounts that are found in the book of Fifths of the Treasury, in the years 1577 and 1578, referring to the "Huaca of Toledo." The following is a condensed inventory:

FIRST.—In Truxillo, Peru, on the 22d of July, 1577, Don Garcia Gutierrez de Toledo presented himself at the royal treasury, to give into the royal chest a fifth. He brought a bar of gold nineteen carats ley and weighing two thousand four hundred Spanish dollars, of which the fifth, being seven hundred and eight dollars, together with one and a half per cent. to the chief assayer, were deposited in the royal box.

SECOND.—On the 12th of December he presented himself with five bars of gold, fifteen and nineteen carats ley, weighing eight thousand nine hundred and eighteen dollars.

THIRD.—On the 7th of January, 1578, he came with his fifth of large bars and plates of gold, one hundred and fifteen in number, fifteen to twenty carats ley, weighing one hundred and fifty-three thousand, two hundred and eighty dollars.

FOURTH.—On the 8th of March he brought sixteen bars of gold, fourteen to twenty-one carats ley, weighing twenty-one thousand one hundred and eighteen dollars.

FIFTH.—On the 5th of April he brought different ornaments of gold, being little bells of gold and patterns of corn-heads and other things, of fourteen carats ley, weighing six thousand two hundred and seventy-two dollars.

SIXTH.—On the 20th of April he brought three small bars of gold, twenty carats ley, weighing four thousand one hundred and seventy dollars.

SEVENTH.—On the 12th of July he came with forty-seven bars, fourteen to twenty-one carats ley, weighing seventy-seven thousand, three hundred and twelve dollars.

EIGHTH.—On the same day he came back with another portion of gold and ornaments of cornheads and pieces of effigies of animals, weighing four thousand seven hundred and four dollars.

The sum of these eight bringings amounted to 278,174 gold dollars or Spanish ounces. Multiplied by sixteen gives $4,450,784 silver dollars. Deducting the royal fifth—$985,953.75—left $3,464,830.25 as Toledo's portion.

Even after this great haul, effigies of different animals of gold were found from time to time. Mantles also, adorned with square pieces of gold, as well as robes made with feathers of divers colors, were dug up. There is a tradition that in the huaca of Toledo there were two treasures, known as the great and little fish. The smaller only has been found.

Between Huacho and Supe, the latter being one hundred and twenty miles north of Callao, near a point called Atahuanqui, there are two enormous mounds, resembling the Campana and San Miguel, of the Huatica valley, soon to be described. About five miles from Patavilca (south and near Supe) is a place called "Paramonga," or the fortress. The ruins of a fortress of great extent are here visible; the walls are of tempered clay, about six feet thick. The principal building stood on an eminence, but the walls were continued to the foot of it, like regular circumvallations; the ascent winding round the hill like a labyrinth, having many angles, which probably served as outworks to defend the place. In this neighborhood much treasure has been excavated, all of which must have have been concealed by the pre-historic Indian, as we have no evidence of the Incas ever having occupied this part of Peru after they had subdued it.

From Lima north along the coast the Ancon & Chancay Railroad is built. Ancon, eighteen miles from Lima, is a favorite summer seaside resort. Just before reaching Ancon, the railroad runs through an immense burying-ground or "huaca." Make a circuit of six to eight miles, and on every side you see skulls, legs, arms, and the whole skeleton of the human body, lying about in the sand. Legs attached to pelvis, and bent up, still with mummified skin on them; arms in the same state; relics of plaited straw, forming coffin swathes; pieces of net, of cloth, and many other such accompaniments of funeral accessories. Some water crafts of very superior quality have been obtained from these graves. Of these there are three different forms, in places separated a short distance from each other, but each style having its defined outline of *locale*. As to the shape of the graves, there are some of an inverted cylinder form, like that of a lime-kiln, the insides of which are lined with masonry work. In these the body is placed in the upright position. There is also the ordinary longitudinal grave, in which the corpse is right in contact with the earth. Likewise the grave cut square to a depth of six to eight feet, at the top of which, or within one or two feet of the surface of the ground, is a roofing or covering of mat work, placed on wooden rafters. In one of these Dr. Hutchinson, her Britannic Majesty's Consul at Callao, found three bodies, all wrapped up together—being a man, woman and child—their faces being swathed with llama wool instead of cotton, as is usually seen in ordinary ones. He also turned out relics of fishing nets, with some

needles for making them, varieties of cloth, tapestry, and work-bags resembling ladies' reticules. Not a vestige of vegetation about, nor sign of relic of the terraces mentioned by Prescott. Whence came these hundreds and thousands of people who are buried at Ancon? How did they make out a living while on the earth? Time and time again the archæologist finds himself face to face with such questions, to which he can only shrug his shoulders and say with the natives, "Quien sabe?" Who knows?

At Pasamayo, 14 miles further "down north," and on the sea shore, is another great burying ground. Thousands of skeletons lie about, thrown out by the treasure-seekers. It has more than a half mile of cutting through it for the Ancon & Chancay R. R. It extends up the face of the hill from the sea-shore to the height of about 800 feet, and being from a half to three-fourths of a mile in breadth, some idea may be formed of its extent.

Dr. Hutchinson, in two days, from these burial grounds, gathered 384 skulls, which, with specimens of pottery, he presented to Professor Agassiz and he to the Cambridge University, near Boston.

Between the teeth he found pieces of copper as if for the Charon obolus, and one or two had plates of copper on their heads.

Crossing the brow of the hill, entering Chancay, and stretching toward the sea, are the remains of a six feet adobe wall. On the face of this hill, pointing to the line of the railway from Ancon, are two stone ditches, perfectly parallel and symmetrical, about 100 yards apart, and running from bottom to top to a height of about 300 yards. Between these are other lines of stone displaced, perhaps the ruins of some old terraces. All about this place, at the base of the hill, looking towards Chancay, as well as on the side in front of the sea, is full of graves; some are built up with stone walls, others lined inside with mud-bricks, of no formation more than a heap of clay and water moulded up in the hands and dried in the sun. Over the hills of Chancay are quantities of small stones of different geological formation from the rock there.

Dr. Hutchinson writes, under date of Oct. 30th, 1872, in an article to the Callao and Lima *Gazette*, now the South Pacific *Times:* "I am come to the conclusion that Chancay is a great city of the dead, or has been an immense ossuary of Peru; for go where you will, on mountain top or level plain, or by the sea side, you meet at every turn, skulls and bones of all descriptions."

Lima, the capital of Peru, is situated seven miles inland from Callao. Nine miles on the sea shore "up south," is the city of Chorillos, the Long Branch of Peru. A railway connects Lima with these two cities, forming with the coast nearly a right angled triangle. This triangular ground is known as the Huatica Valley, and is an extensive ruin. Between Callao and Magdalena, four miles distant, there are seventeen mounds called "huacas," although they present more the form of fortressess, residences or castles, than burying grounds. 'Tis difficult to make out anything but fragments of walls, as the ground is mostly under cultivation. However, at various points, one can see that a triple wall surrounded the ancient city. These walls are respectively one yard, two yards, and

three yards in thickness, being in some parts of their relics, from fifteen to twenty feet high. To the east of these is the enormous mound called Huaca of Pando; and to the west, with the distance of about half a mile intervening, are the great ruins of fortresses, which natives entitle Huaca of the Bell. La Campana, the huacas of Pando, consisting of a series of large and small mounds, and extending over a stretch of ground incalculable without being measured, form a colossal accumulation. The principal large ones are three in number; that holding the name of the "Bell" is calculated to be 108 to 110 feet in height. At the western side, looking towards Callao, there is a square plateau with an elevation of about twenty-two to twenty-four feet, 95 to 96 yards north and south, east and west. At the summit it is 276 to 278 yards long, and 95 to 96 across. On the top there are eight gradations of declivity, each from one to two yards lower than its neighbor; counting in direction lengthwise, the 1st plateau is 96 to 97 yards; 2nd plateau, 96 to 26 yards; 3rd plateau, 23 to 24 yards; 4th plateau, 11 to 12 yards; 5th plateau, 11 to 25 yards; 6th plateau, 23 to 24 yards; 7th plateau, 35 to 36 yards; 8th plateau, 35 to 37 yards; making the total of about 278 yards. For these measurements of the Huatica ruins I am indebted to the notes of J. B. Steere, Professor of Natural History and Curator of the Museum at Ann Arbor, Michigan.

The square plateau first mentioned, at the base, consists of two divisions, one six feet lower than the other, but each measuring a perfect square 47 to 48 yards; the two joining form the square of 96 yards. Beside this, and a little forward on the western side, is another square 47 to 48 yards. On the top, returning again, we find the same symmetry of measurement in the multiples of twelve, nearly all the ruins in this valley being the same, which is a fact for the curious. Was it by accident or design? In its breadth from north to south, three levels are found. The first lower down, 17 to 18 yards wide; the second or highest summit, 59 to 60 yards across; and the third descent again, 23 to 24 yards. The mound is a truncated pyramidal form, and is calculated to contain a mass of 14,641,820 cubic feet of material. For the most part, this great work is composed of adobes, each six inches long, four inches wide, and two and a half inches thick, many having the marks of fingers on them. But this does not consist of more than one-third of the Pando huaca.

Walking down past the southern corner, where the adobes are tumbled into a conglomerate mass by some earthquake, we see skulls with bones of arms and legs, cropping up in many places. The same adobe work is visible throughout, and the whole length of these structures ranges between seven and eight hundred yards. The "Fortress" is a huge structure, 80 feet high, 148 to 150 yards in measurement. Great large square rooms show their outlines on the top, but are filled with earth. Who brought this earth here, and with what object was the filling up accomplished? The work of obliterating all space in these rooms with loose earth must have been almost as great as the construction of the building itself. About two miles south of the last named large fort, and in a parallel line with it as regards the sea, we find another similar structure, probably a little

more spacious and with a greater number of apartments, or divisions by walls, on the top of which we can now walk, as it is likewise filled up with clay. This is called "San Miguel." It is nearly 170 yards in length, and 168 in breadth, and 98 feet high. The whole of these ruins, big fortress, small forts and temples, were enclosed by high walls of adobones, but all of wedge-shaped form, with the sharp edge upward. Adobones are large mud bricks, some from one to two yards in thickness, length and breadth. The huaca of the "Bell" contains about 20,220,840 cubic feet of material, while that of "San Miguel" has 25,650,800. These two buildings were constructed in the same style—having traces of terraces, parapets, and bastions, with a large number of rooms and squares—all now filled up with earth.

Near Lima, on the south, is another mound, 70 feet high and 153 yards square. Near the residence of Par Soldan, the Geographer of Peru, is a mound called "Sugar Loaf," or "San Isidro," 66 feet high, 80 yards broad at the base, and 130 yards long. Professor Raimondi, the naturalist, chemist and scientist, who is doing for Peru what Gay did for Chili, said he found nothing in it but bodies of ordinary fishermen, relics of nets, and some inferior specimens of pottery.

Prof. Steere and Dr. Hutchinson turned out about forty skulls, some bits of red and yellow dyed thread, being relics of cloth; a piece of string made of woman's hair, plaited, about the size of what is generally used for a watch guard; and pieces of very thick cotton cloth, bits of fish nets, portions of slings, and two specimens of crockery ware of excellent material.

About a mile beyond, in the direction of "Mira Flores," is Ocharan, the largest burial mound in the Huatica valley. This mound presents, as it is approached, the appearance of an imposing and enormous structure. It has 95 feet of elevation in its highest part, with an average width of 55 yards on the summit and a total length of 428 yards, or 1,284 feet, another multiple of twelve. It is inclosed by a double wall 816 yards in length by 700 across, thus enclosing 117 acres. Between Ocharan and the ocean are from 15 to 20 masses of ruins, like those already described.

Fifteen miles south of Lima in the valley of Lurin, and near the sea, are the ruins of Pacha Camac, the Inca temple of the sun. Like the temple of Cholula on the plains of Mexico, it is a sort of made mountain or vast terraced pyramid of earth. It is between two and three hundred feet high, and forms a semilunar shape, that is beyond a half mile in extent. Its top measures about ten acres square. Much of the walls are washed over with a red paint, probably ochre, and are as fresh and bright as when centuries ago it was first put on. In these walls in three or four places, are niches, apparently of the same shape and size as we see in the ruins of Pagan temples. From one side, going toward the north, are the relics of a wall, which is covered with soot, possibly the remnant of fires to make sacrifices, and nothing can better illustrate the conservative tendency of the Peruvian climate than the fresh appearance of the soot. Prescott says of Pacha Camac, that it was to the Peruvians what Mecca is to the Mahometan, and Cholula was to the Mexican.

In the Canete valley, opposite the Chincha Guano Islands, are extensive ruins. In that region a terra-cotta mask was found, similar to that of which there is a drawing in Mr. Squiers' report of his explorations in the State of New York, and discovered while excavating for the St. Lawrence canal. From the hill called "Hill of Gold," copper and silver pins were taken like those used by ladies to pin their shawls; also, tweezers for pulling out the hair of the eye-brows, eye-lids and whiskers, as well as silver cups.

Buried 62 feet under the ground on the Chincha Islands, stone idols and water pots were found, while 35 and 33 feet below the surface were wooden idols. Beneath the Guano on the Guañapi Islands, just south of Truxillo, and Macabi just north, mummies, birds and bird's eggs, gold and silver ornaments were taken. On the Macabi the laborers found some large valuable golden vases, which they broke up and divided among themselves, even though offered weight for weight in gold coin, and thus have relics of greatest interest to the scientist been forever lost. He who can determine the centuries necessary to deposit thirty and sixty feet of guano on these islands, remembering that, since the conquest three hundred years ago, no appreciable increase in depth has been noted, can give you an idea of the antiquity of these relics.

The coast of Peru extends from Tumbez on the north to the river Loa on the south, a distance of 1,235 miles. Scattered here and there over this whole extent, there are thousands of ruins beside those just mentioned, and similar, only not so extensive; while nearly every hill and spur of the mountains have upon them or about them some relic of the past; and in every ravine from the coast to the central plateau, there are ruins of walls, fortresses, cities, burial vaults, and miles and miles of terraces and water courses. Across the plateau and down the eastern slope of the Andes to the home of the wild Indian, and into the unknown, impenetrable forest, still you find them. In 1861, Mendoza, in the Argentine Republic, a beautiful city on the plain, 45 miles from the foot of the Andes, in the short space of five minutes was a complete ruin, and 15,000 out of her 20,000 inhabitants, or 75 per cent., were in the arms of death. In 1871 it was still exactly as on the evening of her destruction; the miles of skeletons lying uncovered where they perished, and the streets yet obstructed with the debris of the fallen walls of the houses. A new city has been built beside the old one. Seeking a photograph of the ruins, I was told there were none. Persuading one of the artists to take some views of them, and going to see the proof, he told me he had been out all day and had done nothing, as he could find nothing to take "but a pile of dirt." Thus, also, you might, as most do, style these coast ruins, and those who live among them understand and appreciate them no better than did the Mendoza artist the ruins of that ill-fated city.

In the mountains, however, where storms of rain and snow with terrific thunder and lightning are nearly constant a number of months each year, the ruins are different. Of granitic, porphyritic, lime and silicated sand-stone, these massive, colossal, cyclopean structures have resisted the disintegration of time, geological transformations, earthquakes, and the sacrilegious, destructive hand of

the warrior and treasure-seeker. The masonry composing these walls, temples, houses, towers, fortresses, or sepulchres, is uncemented, held in place by the incline of the walls from the perpendicular, and adaptation of each stone to the place destined for it, the stones having from six to many sides, each dressed, and smoothed to fit another or others, with such exactness that the blade of a small pen knife cannot be inserted in any of the seams thus formed, whether in the central parts entirely hidden, or on the internal or external surfaces. These stones, selected with no reference to uniformity in shape or size, vary from one-half cubic foot to 1,500 cubic feet solid contents, and if, in the *many, many millions* of stones you could find *one* that would fit in the place of another, it would be purely accidental. In "Triumph street," in the city of Cuzco, in a part of the wall of the ancient house of the virgins of the sun, is a very large stone, known as "the stone of the twelve corners," since it joins with those that surround it, by twelve faces, each having a different angle. Beside these twelve faces it has its external one, and no one knows how many it has on its back that is hidden in the masonry. In the wall of the center of the Cuzco fortress there are stones 13 feet high, 15 feet long, and eight feet thick, and all having been quarried miles away. Near this city there is an oblong smooth boulder 18 feet in its longer axis, and 12 in its lesser. On one side are large niches cut out, in which a man can stand, and by swaying his body cause the stone to rock. These niches apparently were made solely for this purpose. One of the most wonderful and extensive of these works in stone, is that called Ollantay-Tambo, a ruin situated thirty miles north of Cuzco, in a narrow ravine on the bank of the river Urubamba. It consists of a fortress constructed on the top of a sloping, craggy eminence. Extending from it to the plain below, is a stone stairway. At the top of the stairway are six large slabs, twelve feet high, five feet wide, and three feet thick, side by side, having between them and on top narrow strips of stone about six inches wide, frames as it were to the slabs, and all being of dressed stone. At the bottom of the hill, part of which was made by hand, and at the foot of the stairs, a stone wall ten feet wide and twelve feet high extends some distance into the plain. In it are many niches, all facing the south.

The ruins on the islands in Lake Titicaca, where Incal history begins, have often been described.

At Tiahuanaco, a few miles south of the lake, there are stones in the form of columns, partly dressed, placed in line at certain distances from each other, and having an elevation above the ground of from eighteen to twenty feet. In this same line there is a monolithic doorway, now broken, ten feet high by thirteen wide. The space cut out for the door is seven feet four inches high, by three feet two inches wide. The whole face of the stone above the door is engraved. Another, similar, but smaller, lies on the ground beside it. These stones are of hard porphyry, and differ geologically from the surrounding rock, hence, we infer they must have been brought from elsewhere.

At "Chavin de Huanta," a town in the province of Huari, there are some ruins worthy of note. The entrance to them is by an alley-way six feet wide and

nine feet high, roofed over with sand-stone partly dressed, of more than twelve feet in length. On each side there are rooms twelve feet wide, roofed by large pieces of sand-stone one and a half feet thick and from six to nine feet wide. The walls of the rooms are six feet thick, and have some loop-holes in them, probably for ventilation. In the floor of this passage there is a very narrow entrance to a subterranean passage that passes beneath the river to the other side. From this many huacos, stone drinking vessels, instruments of copper and silver, and a skeleton of an Indian sitting, were taken. The greater part of these ruins are situated over aqueducts. The bridge to these castles is made of three stones of dressed granite, twenty-four feet long, two feet wide by one and a half thick. Some of the granite stones are covered with hieroglyphics.

At Corralones, twenty-four miles from Arequipa, there are hieroglyphics engraved on masses of granite, which appear as if painted with chalk. There are figures of men, llamas, circles, parallelograms, letters, as an R and an O and even remains of a system of astronomy.

At Huaytar, in the Province of Castro Virreina, there is an edifice with the same engravings.

At Nazca, in the Province of Ica, there are some wonderful ruins of aqueducts, four to five feet high and three feet wide, very straight, double walled, of unfinished stone, flagged on top.

At Quelap, not far from Chochapayas, there have lately been examined some extensive works. A wall of dressed stone 560 feet wide, 3,660 long, and 150 feet high. The lower part is solid. Another wall above this has 600 feet length, 500 width, and the same elevation of 150 feet. There are niches over both walls, three feet long, one and a half wide and thick, containing the remains of those ancient inhabitants, some naked, others enveloped in shawls of cotton of distinct colors, and well embroidered. Their legs were doubled so that the knees touched the chin, and the arms were wound about the legs. The wall has three uncovered doors, the right side of each being semicircular, and the left angular. From the base an inclined plane ascends almost insensibly the 150 feet of elevation, having about mid-way a species of sentry box in stone. In the upper part there is an ingenious hiding place of dressed stone, having upon it a place for an outlook from which a great portion of the Province can be seen. Following the entrances of the second and highest wall, there are other sepulchres like small ovens, six feet high and twenty-four in circumference, in their base are flags, upon which some cadavers reposed. On the north side there is, on the perpendicular rocky side of the mountain, a brick wall, having small windows 600 feet from the bottom. No reason for this, nor means of approach, can now be found. The skillful construction of utensils of gold and silver that were found here, the ingenuity and solidity of this gigantic work of dressed stone, make it, also, probably of pre-Incal date.

To support the inhabitants, it became necessary to cultivate every part of the land possible, and since the greater portion is mountainous, they could make no use of that land except by such means as they adopted, i. e., by terraces.

Along the side, at the base of a hill or mountain, a stone wall is laid from one to eight feet high, according to the slope, and earth filled in between it and the side of the mountain, till even with the wall. Having this level for a base, another wall is laid, and again earth filled in, and so on, tier above tier, as high as the place will permit. These are terraces. The summits of the mountains are saturated with water from the melting snow or winter rains. This, forming little streams, is guided over these terraces. Each terrace is divided into patches by making a little ridge of earth a few inches high all around them, enclosing places two feet by six, or eight feet by ten, and so on according to the size of the terrace. The top terrace is first flooded, the ridge of earth serving as a dam. When it is considered wet enough, a channel is made by taking out a part of the ridge (with the hand or a little paddle about the size of a pancake turner) permitting the water to escape to the part below, flowing over the wall to the next terrace, which is similarly treated. But there are thousands of terraces where the mountains and hills are so low and near the rainless portion that snow never, and rain very seldom, moistens their summits, and where no one could expect water for irrigation unless carried there by hand. Starvation alone would compel people to undertake so fatiguing and laborious a work, especially in a country where the evenness of the climate tends to relax the energy of both mind and body. Estimating five hundred ravines in the twelve hundred miles of Peru, and ten miles of terraces of fifty tiers to each ravine, which would only be five miles of twenty-five tiers to each side, we have 250,000 miles of stone wall, averaging three to four feet high—enough to encircle this globe ten times. Surprising as these estimates may seem, I am fully convinced that an actual measurement would more than double them, for these ravines vary from thirty to one hundred miles in length, and ten miles to each is a low estimate. While at San Mateo, a town in the valley of the river Rimac, seventy-seven miles from the coast, where the mountains rise to a height of fifteen hundred or two thousand feet above the river bed, I counted two hundred tiers, none of which were less than four and many more than six miles long. Even at four miles, there would be at that point alone eight hundred miles of stone wall, and that only on one side of the ravine.

Who, then, were these people, cutting through sixty miles of granite, transporting blocks of hard porphyry, of Baalbic dimensions, miles from the place where quarried, across valleys thousands of feet deep, over mountains, along plains, leaving no trace of how or where they carried them; people ignorant of the use of iron, with the feeble llama their only beast of burden; who, after having brought these stones together and dressed them, fitted them into walls with mosaic precision; terracing thousands of miles of mountain side; building hills of adobes and earth, and huge cities; leaving works in clay, stone, copper, silver, gold and embroidery, many of which cannot be duplicated at the present age; people apparently vying with Dives in riches, Hercules in strength and energy and the ant and bee in industry?

Callao was submerged in 1746 and entirely destroyed. Lima was ruined in 1678—in 1746 only twenty houses out of three thousand were left standing—and

again injured in 1764, 1822 and 1828, while the ancient cities in the Huatica and Lurin valleys still remain in a comparatively good state of preservation. San Miguel de Piura, founded by Pizarro in 1531, was entirely destroyed in 1855, while the old ruins near by suffered little. Arequipa was thrown down in August, 1868, but the ruins near show no change.

Spanish writers refer all to Incal make, but Incal history only dates back to the eleventh century, and from that time to the Conquest is insufficient, nor do they speak of many of these works. It is granted that the Temple of the Sun, at Cuzco, was of Incal make, but that is the latest of the five styles of architecture visible in the Andes, each probably representing an age of human progress; therefore we are pretty certain that the imperial glories of the Incas were but the last gleam of civilization that mounted up to thousands of years; that long before Manco Capac, the Andes had been the dwelling place of races whose beginnings must have been coeval with the savages of Western Europe. The gigantic architecture points to the Cyclopean family, the founders of the Temple of Babel and the Egyptian Pyramids. The Grecian scroll found in many places, borrowed from the Egyptians; the mode of burial and embalming their dead, points to Egypt as their similar, while the distaff, plow, manner of threshing and of making brick, are the same as when the Israelites were captives.

The hieroglyphics, to none of which as yet a key has been found, cannot be referred to the Incas, since they apparently had no knowledge of characters, but kept their records and accounts by means of a quippus, or knots and different colored threads, as did those in Asia, China, Mexico and Canada, in ancient times, and they kept in each city an official whose business it was to keep and decipher their quippus. It was made of twisted wool, and consisted of a thread or thick string, from one to eighteen feet long, as a base upon which other threads or strings were attached. The different colors had different significations: the red, soldier or warrior; the yellow, gold; the white, silver or peace; the green, wheat or corn, and so on. In numerals, one knot signified ten; two simple knots, twenty; the knot doubly interlaced, one hundred; trebly interlaced, one thousand; two interlacings of this latter, two thousand. By setting apart a quippus for the military, another for laws and decrees, another for historic events —i. e., a separate quippus for distinct classes of ideas—the same knots could be used many times over, but to read them one must know to which class they belonged. Certain signs were affixed to the beginning of each "mother-thread," as the base or principal string was called, by which the official could distinguish each; however, should an official visit another locality, these signs had to be explained verbally, also the signs representing local events, names of rivers, mountains, ships, cities, etc. Hence, a quippus was only intelligible, for the most part, in the place it was kept. Many quippus have been taken from the graves, in excellent state of preservation in color and texture, but the lips that alone could pronounce the verbal key, have forever ceased their function, and the relic seeker has failed to note the exact spot each was found, so that the records which could tell so much we want to know, will remain sealed till all is revealed at the last day.

The skulls taken from the burial-grounds, according to craniologists, represent three distinct races.

The first, to which the name "Chinchas" has been given, occupied the western part of Peru from the Andes to the Pacific, and from Tunebez on the north to the desert of Atacama on the south.

The second, called "Aymaras," dwelt in the elevated plains of Peru and Bolivia, on the southern shore of lake Titicaca, where they reside even to this day, being the only race that did not give up their language for the Inichua, or language of the Incas, when conquered by them.

The third, called "Huancas," occupied the plateau between the chains of Andes north of lake Titicaca to the 9th degree of south latitude. This race were supposed to have caused the peculiar shape of their heads by mechanical means, as the Flat head Indians with us, and the Conibos, a tribe that now live on the banks of the Ucayali near Sarayacu, but the taking from a mummy of a fœtus of seven or eight months having the same configuration of the skull, has placed a doubt as to the certainty of this fact.

How changed! How fallen from their greatness must have been the Incas when a little band of 160 men could penetrate uninjured to their mountain homes, murder their worshiped kings and thousands of their warriors, and carry away their riches, and that, too, in a country where a few men with stones could resist successfully an army! Who could recognize in the present Inichua and Aymara Indians their noble ancestry?

Their songs are typical of their condition, and are called "tristes," or sad songs. Always a duet in a minor key, and at night as you hear it, it seems rather the expiring wail of some lost spirit than a human voice. It begins with a full inspiration of the lungs and at the highest pitch of the voice, and ends with the expiration of the breath in a low, long drawn out "andante pianissimo." The words are chanted and often made up for the occasion. These are the words heard by a traveler from the lips of a young Indian mother, in the wild recesses of the Andes:

"My mother begat me amid rain and mist,
To weep like the rain and be drifted like the clouds.
You are born in the cradle of sorrow,
Says my mother; and she weeps as she wraps me around.
If I wander the wide world over,
I could not meet my equal in misery.
Accursed be the day of my birth,
Accursed be the night I was born,
From this time, for ever and ever!"

Three times the Andes sank hundreds of feet beneath the ocean level, and again were slowly brought to their present height. A man's life would be too short to count even the centuries consumed in this operation. The coast of Peru has risen eighty feet since it felt the tread of Pizarro. Supposing the Andes to have risen uniformly and without interruption, seventy thousand years must have elapsed before they reached their present altitude.

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Who knows, then, but that Jules Verne's fanciful idea regarding the lost continent Atlanta may be near the truth? Who can say, that where now is the Atlantic ocean, formerly did not exist a continent, with its dense population, advanced in the arts and sciences, who, as they found their land sinking beneath the waters, retired, part east and part west, populating thus the two new hemispheres? This would explain the similarity of their archæological structures and races and their differences, modified by and adapted to the character of their respective climates and countries. Thus could the llama and camel differ, although of the same species; thus the algoraba and espino trees; thus the Iroquois Indians of North America and the most ancient Arabs call the constellation of the "Great Bear" by the same name; thus various nations, cut off from all intercourse or knowledge of each other, divide the Zodiac in twelve constellations, apply to them the same names, and the northern Hindoos apply the name Andes to their Himalayan mountains, as did the South Americans to their principal chain. Must we fall in the old rut and suppose no other means of populating the Western Hemisphere except "by way of Behring's strait?" Must we still locate a geographical Eden in the East, and suppose a land equally adapted to man and as old geologically, must wait the aimless wanderings of the "lost tribe of Israel" to become populated?

Beside dead and speechless relics of the past, there exists a living antiquity. In 7° south latitude, a couple of miles from the sea, there is a town of about 4,000 inhabitants called Eten. They speak, besides the Spanish, a language that some of the recently brought over Chinese laborers understand, but differ in all other respects. They intermarry brothers and sisters, uncles and nieces, nephews and aunts, i. e. promiscuously, with no apparent curse of consanguinity. They are exclusive, permitting no intermarriage into their number or with the outside world. They have laws and customs and dress of their own, and live by braiding hats, mats, and weaving cloths. They will give no account of when they came or from whence, nor does history mention them as existing before the Spaniards came, nor does it record their arrival since. Among them you will find no sick or deformed people, their custom being to send a committee to each sick or old person, and if they judge the patient past recovery or the aged past usefulness, the public executioner is sent and they are strangled. Eten orders it, they say, and none ever interfere with these orders.

Thirteen thousand years ago, *Vega*, or *a. Lyræ*, was the north polar star. Since then how many changes has she seen in our planet? How many nations and races spring into life, rise to their zenith splendor and then decay; and when we shall have been gone thirteen thousand years, and once more she resumes her post at the north, completing a "Platonic, or Great Year," think you that those who shall fill our places on the earth at that time will be more conversant with our history than we are of those that have passed? Verily might we exclaim in terms almost Psalmistic, Great God, Creator and Director of the Universe, what is man that Thou art mindful of him!

THE GREAT PYRAMID IN CONNECTION WITH CHRONOLOGY.

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ARTICLE III.

"Chronology is the science which treats of measuring or computing time by regular divisions or periods, and which assigns to events or transactions their proper dates." As time embraces events, so chronology includes history. It is a very perplexing study, on account of the wide difference of dates assigned by different historians to the same historical occurrences. Egyptologists, although they now generally agree in the order of precedence or comparative succession of events; yet they vary in the dates of *early* Egyptian dynasties, in consequence of their inability to determine whether they were coëistent over different provinces, or successive over the whole, which would make a variation of from 1,000 to 3,000 years. Perhaps the Great Pyramid may be allowed to step in and harmonize the conflicting theories on this subject, as it has on some others. We propose to show how scholars have endeavored to determine dates in Egypt, and then what it is claimed that this gigantic old wonder, that we have found chock-full of other sciences, contains.

This huge pillar, on which uneducated eyes never saw anything to wonder at, but vastness in extent, is a magnificent school book, wonderful for its scope of scientific subjects, and marvelous for its correctness. It was made so firm, and with such dextrous skill, that it has never worn out like other books, and it has never been destroyed. It has been badly used and mutilated. It has been stripped of its plain, substantial covers, and its fly leaves have been torn. But its *lessons* have been wonderfully preserved. They seem to have been put there, as old Job said he would like to have his book printed, *with an iron pen in a rock forever*. Perhaps his desire was gratified, and this was his book! Who knows? At any rate, he seemed to have had an idea of a very durable book made in this manner. And in some way he got hold of some of the advanced science contained in this book, before Copernicus, or Kepler, or Newton did. Where did Job learn that the earth hangs upon nothing? (Compare Job 26:7, with 38:4—7, 31.) Some think Job might have been that shepherd whom Herodotus writes about, who was in consultation with King Cheops much of the time during the Pyramid's erection, and who seemed to be the architect, directing the workmen. There was such a shepherd, but that *Job was* this shepherd, this deponent saith not. But he does say that this book was made so perfect at first that it never, like other books, needed a new and corrected edition. It presented science so pure and high, that it could not have been read, so as to have been understood, till the great natural laws discovered by Copernicus and Newton were understood. Hence the reason for its remaining a sealed book so long. If its lessons had been read before, they would not have been believed, for they contradicted the current opinions of all ancient scholars. And whoever now attempts to explain

any of the scientific symbols contained therein on false principles, will fail to find anything wonderfully instructive here. It must be studied like any other book. Prof. Piazzi Smyth and others claim that this remarkably scientific volume, which antedates by thousands of years the attainment, by any known means, of the knowledge it contains, was inspired, as Solomon's temple was. Considering how it approximates perfection, does it not become critical opponents of this theory, in endeavoring to undermine it of its claim, either to convict it of error in its teachings, or show that the ancients were in advance of the scholarship of our age?

We will now show how scientists have endeavored to determine dates in Egypt; 1st, on Geological, 2nd on Astronomical; and 3d, on Monumental grounds.

1st, Geologically. Scientists argue that man has existed in Egypt in a civilized state, more than 13,000 years. How? They say that pieces of pottery, and other solid substances, have been found at so great a depth in the alluvial deposits of the Nile, that it must have required, according to geological laws, more than 13,000 years for them to have become buried so deep. But do not scholars equally eminent assert that these solid substances which are found so deep, never were buried there, but sunk down there from the top? It has been proven that there is a tendency in a solid body to sink downward, through a bed of earth made up of such fine particles as the soil of the Nile contains, and that therefore it would be utterly impossible to determine definitely any age in this way. Prof. Balfour Stewart, of Manchester, England, has been experimenting in order to test this theory, and he professes to have ocular demonstration of the fact. Concerning this tendency, we of Colorado have ample proof in our placer mines. Where do miners find gold? Invariably on bed-rock, as deep down as it is possible for the gold to sink. No one indulges the thought for a moment that the gold was buried where it is found. In accordance with the invariable laws of gravitation, when it was washed down from the mountains, it sought and found the only kind of position suited to its specific gravity, as compared with its surroundings. Only when it could not possibly go farther, did it cease to sink. But we have had in Colorado other proofs of the uncertainty of this method of determining dates, not likely soon to be forgotten. During the great flood in Denver, A. D. 1863, when the court-house, which stood on the hitherto dry bed of Cherry creek, was washed away, the iron safe sunk so deep that it has never been found to this day, although the bed of Cherry creek is usually so hard that scarcely an impression is made on it in walking over it.

A more remarkable case still occurred early last summer, about thirty miles east of Denver, when a locomotive of thirty tons weight went down in the bed of a little creek, which is scarcely wider than the locomotive's length, and has never been seen since, although the bed of this creek is usually dry and hard. When we last passed this spot, more than three months afterward, the railway company were expending about one hundred dollars per day in searching for their absconding engine, which they had been unable to find, either by driving down long iron rods, or by a steam excavator. They had, however, found the

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tender and the three drowned men, whose specific gravity was not sufficient to escape so fast.

Now, suppose the soil in the Kiowa to be like what the engine has passed through, for one thousand feet deep, and that the engine should be given up as lost, and be forgotten, and that by accident it should be found, several generations hence, how many hundreds of thousands of years do you think it will then be accredited with having been buried, by some lecturer of geology of that age, and what hypothesis will he advance concerning his discovery, as connected with the lost arts?

A case somewhat similar to this occurred about twenty years ago, opposite Atchison, Kansas. A boat loaded with whisky, much larger than the locomotive referred to and of much less specific gravity, played truant in the same way in the Missouri river. The cargo of ardent spirits presented quite an inducement to search for it. The river was industriously probed with iron rods, and explored in every direction and in every conceivable way. But all to no purpose; it had gone, with *kindred* spirits, down into old Pluto's regions, where it properly belonged!

If geology can furnish no stronger proof of man's pre-historic existence in Egypt, than deep-buried solid substances in alluvial deposits, it must be set aside as an incompetent witness. For only those with whom "the wish is father to the thought," will credit such testimony. We admit, however, that this geological argument applies only to the peculiar kind of earth described. But as this is the only kind in all Egypt, where any such relics have been discovered, it covers the ground occupied in this discussion.

But it is not alluvial soil only that admits the penetration of solid substances. We know of railroads that for a considerable distance are now literally "*underground*" railroads, that sunk by their own weight, in mud which was firm enough to bear up heavy teams and to produce rank vegetation. Where the road sank it left a lake. Suppose these railroads should be discovered after our race (by some catastrophe) is destroyed; how conclusively they would prove, to some credulous creatures in the distant future, that not only we, but pre-historic man also, knew all about railroads. It is well known that a considerable portion of the Southern Pacific Railroad is now located far below the level of the Pacific Ocean. An earthquake at any time is liable to overflow it! What would such an event prove with regard to ancient ruins found beneath oceans, seas or lakes?

Would it be strange at any time if, in a large portion of Southeast Missouri, solid substances should be found far beneath the earth's surface, which sank there during the fall and winter of A. D. 1811–12? The earth there, at that time, was constantly opening, and spouting, and closing up, for months, till the mighty power which occasioned it found vent and spent itself in the terrible destruction of Caraccas, in South America. This occurred when tall trees were there, and still now are growing luxuriantly. There are many ways of accounting for the ancient underground works of man, without resorting to the *gradual* covering up thereof by successive layers of earth.

Now let us look at the astronomical argument. When the French under Bonaparte, A. D. 1798, invaded Egypt, savants were allowed to accompany the army for protection while studying Egyptian archæology. Being provided with donkeys, on which to carry their instruments, papers and specimens, they could not safely pursue their investigations without military escorts. It is said that when the army was threatened with an attack from the Mameluke cavalry, it formed into a hollow square, and the orders were: "Savants and donkeys to the center! March!" Connecting savants with donkeys was a soldier's joke, but it shows how they were protected to be enabled to accomplish their perilous tasks. They finally reached Upper Egypt, and there they discovered several zodiacs on the ceilings or walls of ancient temples or palaces. These zodiacs were constructed with the equator crossing the ecliptic on different longitudinal lines. These French astronomers took it for granted that the ages of these zodiacs corresponded with the time indicated by these crossings; so, hurriedly and exultingly, they published to the world that they had found incontrovertible evidence of the existence of civilized man in Egypt for at least 17,000 years.

The theory of proving dates by zodiacs seemed plausible without the explanations: but when explained it appeared that these painted zodiacs were mere dumb watches that told no time; that they were the work of ornamental artists, (*after the Roman conquest of Egypt,*) who had no knowledge whatever of Astronomy and who ran the equator across the ecliptic without regard to what it would signify astronomically, just as toy-makers construct dumb watches, without regard to their noting any specified time. This fact would be enough of itself to throw a doubt over the conclusions of these French archæologists. But the *fatal* argument, the one which completely *annihilated* their theory, was this: All of these zodiacs carried with them the dates of their construction, in hieroglyphic inscriptions. These French savants had not the means, at that time, of deciphering these inscriptions, (the Rosetta stone not having been yet discovered.) *Now* these dates are read and understood, and none of them are of greater antiquity than the Roman conquest of Egypt. Bunsen says, "the signs of the Zodiac were wholly unknown to the Egyptians till the reign of Trojan. So these remarkably sensational old relics, on which implicit reliance was placed for a time, in proving man's very remote antiquity, were convicted of incapacity to testify to any event that occurred before the Christian era; this is now universally admitted.

Thus was suddenly exploded the theory of man's very remote prehistoric existence, based on astronomical calculations. In accordance with an old adage, "*it went up like a rocket, and came down like a stick.*"

The only other astronomical argument determining a date in Egypt is that founded on the precession of the equinoxes, as discovered on the old, original, *real* Zodiac. This is a great clock which God Almighty made, and hung up in the heavens at the creation, to be the time-piece of the ages. It is the clock He works by Himself in running the machinery of His great work-shop. It never needs winding-up, and never stops or gets out of order. Its signs, Aries, Tau-

rus, Gemini, Cancer, etc., like the minute hand or pointer, mark with accuracy, 50.18" of a degree each year. So it will take twenty-five thousand eight hundred and twenty-seven years for these signs to get round on the ecliptic just *once.*

By seeing where the Pleiades now are, we can count 50.18" of a degree for each year till we get back to its Right Ascension, or the epoch of this grand cycle. This will count up now to four thousand and forty-eight years, or to 2170 B. C. This counting can be done, with the aid of proper instruments, by any one who understands astronomy. It is as simple as the counting of the hours and minutes and seconds on a watch. It was in this way that Herschel, Smyth and others adjusted the epoch of the Pyramid of Cheops, astronomically, at 2170 B. C., after they had learned from other sources its approximate date.

Now, we will examine this subject from a monumental standpoint.(?) Chronology, determined on monumental grounds, is based on examples more abundant and more easily understood than that which is determined astronomically.

Building monuments and inscribing events on them, seemed to be the principal business of the Egyptians. Their country is full of old stone relics, in both Upper and Lower Egypt. They include not only huge pyramids, but colossal temples, some of them hollowed out of solid rocks; tombs built in imitation of mountains, colossal obelisks, statuary, &c., which are covered all over with deep, clearly cut, hieroglyphic inscriptions, which time (in that dry climate) has not obliterated. These determine the age of the monuments on which they are inscribed as coeval with certain kings. They are the libraries of that period. Job's notion of a "*book written with an iron pen in a rock forever,*" was no fanciful expression. It was the Egyptian common method of making books in Job's day.

Dr. Lepsius, the most distinguished Egyptologist in all the world, has an ancient volume of this kind, to-day, in his library at Berlin, and he *has compiled and published an Egyptian history from a monumental standpoint, chronologically arranged.* This history is of *very great value* in this discussion, because capable of being proved reliable by inscriptions on monuments now in existence. We copy, therefore, copiously from this most distinguished German scholar. He says, as follows: "An intense desire after posthumous fame, and a place in history seems to have been universal in ancient Egypt. This exhibits itself in the incredible multitude of monuments, of all descriptions, which have been found in the valley of the Nile. All of the principal cities of Egypt were adorned with temples and palaces. Towns of lesser note, and even villages, were distinguished by one temple at least—oftener more. These temples were filled with the statues of gods and kings, generally colossal and hewn from costly stones. Their walls, also, within and without, were covered with colored reliefs. To adorn and maintain these public buildings was at once the duty and pride of the kings of Egypt. But even these were rivaled by the more opulent classes of the people, in their care for the dead and in the hewing and decoration of sepulchred chambers. In these things the Egyptians very far surpassed the Greeks and Romans as well as other known nations of antiquity.

Still farther to enchance to after times the value of these ever enduring mon-

uments of ancient Egypt, it was universal with the inhabitants to cover their works of art of every description with hieroglyphics, the purport of which related strictly to the monuments on which they were inscribed. No nation that ever lived on the earth has made so much use of its written system, or applied it to a purpose so strictly historical as ancient Egypt.

There was not a walk, a platform, a pillar, an architrave, a frieze, or even a door-post in an Egyptian temple that was not carved within and without, and on every available surface, with pictures in relief. *There is not one of these reliefs that is not history*, some of them representing the conquests of foreign nations, others the offerings and devotional exercises of the monarch, by whom the temple, or portion of the temple on which the relief stood, had been constructed.

Widely different from the temples of Greece and Rome, on which inscriptions were evidently regarded as unwelcome additions, forming no part of the original architectural design, but, on the contrary, interfering with and marring it. The hieroglyphic writings were absolutely essential and indispensable to the decoration of a perfect Egyptian temple. This writing was not confined to constructions of a public nature, such as temples and tombs, but inscribed on objects of art of every other conceivable description, even the pallet of a scribe; the style which a lady painted her eye-lashes, or a walking stick; nothing was too insignificant to be inscribed with the owner's name. Inscriptions with names of artists or owners, so rare on Grecian and Roman remains, are the universal rule in Egyptian art. There was no column too great, and no amulet too small, to be inscribed with the owner's name, with an account of the occasion on which it was executed."

Chevalier Bunsen, another celebrated Egyptologist, says: "No nation of the earth has shown so much zeal and ingenuity, so much method and regularity in recording the *details of private life*, as the Egyptians. No country in the world has afforded greater facilities for indulging such a propensity, than Egypt, with its lime-stone and granite, its dry climate, and the protection afforded by its desert, against the overpowering force of nature in Southern zones. Such a country was adapted, not only for securing its monuments against dilapidation, both above and below ground, for thousands of years, but even for preserving them, as perfect as the day they were erected. In the north, rains and frost corrode; in the South the luxuriant vegetation cracks and obliterates the monuments of time. China has no architecture to bid defiance to thousands of years. Babylon had but bricks. In India the rocks can barely resist the wanton power of nature."

Renan, in alluding to the exceeding plain and unmistakable records of their doings as seen in their hieroglyphic inscriptions says, very quaintly: "*We have Egypt caught in the fact.*"

These ancient monuments, being all in old Egyptian style, were, till the beginning of the present century, erroneously supposed to have been about equally ancient. But when the hieroglyphics were deciphered, they corrected this mis-

take, so that now, in the nineteenth century, we know more about Egypt than any people before for thousands of years.

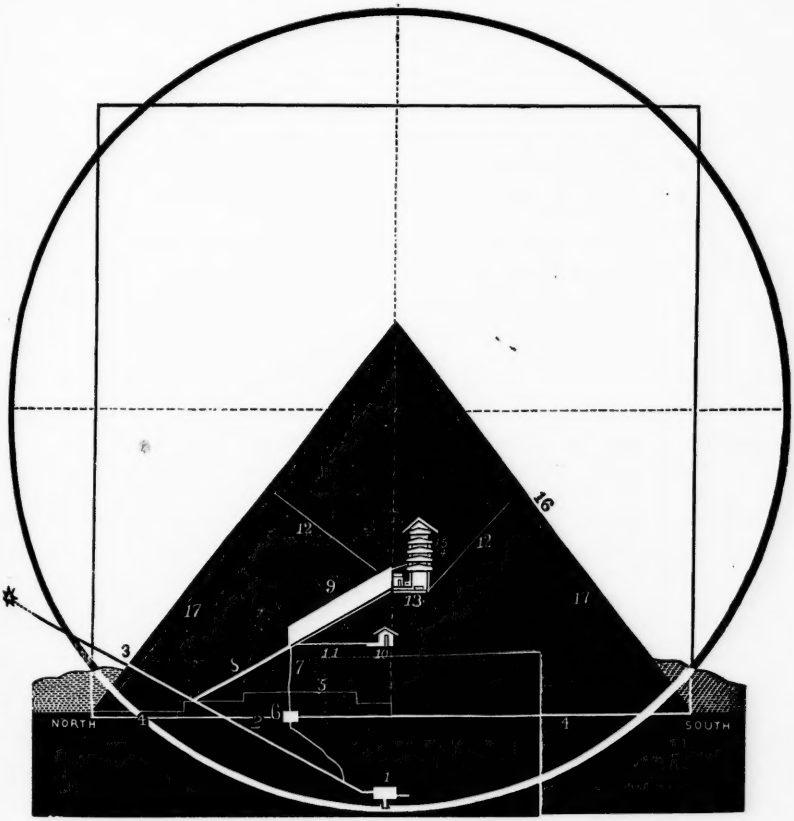
According to Young and Champollion, the great hieroglyphic scholars and expounders, these stone structures were erected at widely different times, and under very different circumstances. They not only carry their own evidence with them of their proper place in a chronological table, but show conclusively that they belonged to four distinct epochs:

1. The first and oldest of these are the Pyramids. 2. *The second and next, in order of age, are the most ancient of the temples in Upper Egypt.* (These were built before and about the time of Shishack, of the twenty-second dynasty, who was contemporary with King Solomon. *3. Those of the third epoch were erected after the conquest of Egypt by the Greeks. 4. Then follow, fourthly, those erected after the conquest of Egypt by the Romans.* It was on these last ones that artists and house-painters inscribed Zodiacs. As none of the Zodiacs referred to were found on the ruins which belong to the first three epochs named, it is evident that they could not have been older than the monuments of the fourth epoch, on which they were inscribed.

Among the pyramids, which signalize the first epoch, the Great Pyramid of Cheops is accredited as being the oldest. *Dr. Lepsius calls it "the first link in all monumental history, not only in Egypt, but in all the world."* No one will contend that there is any better authority. In producing his evidence that this pyramid is the oldest, he says, Cheops attached the figure of a pyramid to his signature. This was, at least, symbolical testimony that he built the pyramid; and no such figure was found attached to any earlier king's signature, although several of Cheops' successors, who also built pyramids, adopted the figure in their cartouches. King Cheops' signature has been discovered on the underside of stone in the pyramid, where it could not possibly have been inscribed upon it after it was erected. So it is admitted that he is the most ancient king in the world whose name has been found on a monument of his own construction.

The history of Egypt before Cheops, during the three previous dynasties, is all traditional and mythical; for the previous kings are known in tradition only as god-kings, who belong to the realms of mythology rather than reliable history. Copies of their cartouches or signatures, from Merces of the first dynasty, down to the third, are handed down to us by tradition, but as there are no monuments in existence on which they have been found inscribed, they do not come within our range of argument in a scientific discussion, which is based on *monumental* testimony. *Now it is claimed that in the avenues and other internal arrangements of the Pyrawid of Chepos are found, not only the date of its erection, but also a symbolical history (older than letters) of Judaism and Christianity, chronologically arranged, which agrees with both the facts and Bible history of the same.*

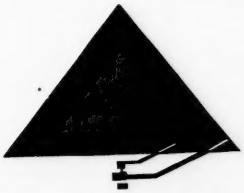
Such chronology as this includes not only a history of the past, but of the future! It is prophecy! And, as Hume says, "Prophecy is a miracle!" So be it! And perhaps this pyramid may yet prove, even to the most skeptical, that a miracle is possible. Who knows but the building itself (though unlike any



XUT—SPLENDID. PYR-MET or PYRAMID OF CHEOPS.

1. Lower chamber. 2. Descending passage. 3. Entrance. 4. Natural rock platform. 5. Natural rock. elevation. 6. Cavern. 7. Well hole. 8. Ascending passage. 9. Great Gallery. 10. Queen's chamber. 11. Passage from the Great Gallery to Queen's Chamber. 12 Passage for ventilation. 13. King's chamber. 14,15. Small apartments above King's Chamber. 16. Outer surface with casing. 17. Outer surface with casing removed. Angle of slope of 1st Pyramid, 51°, 51′, 14.3″. Angle of slope of 2d Pyramid, 52°, 20′. Angle of slope of 3d Pyramid, 51°, 0′.

SECOND PYRAMID. UR—GREAT.



THIRD PYRAMID. HIR—SUPERIOR.

other building that man ever dreamed of), fulfills certain prophecy? "In that day there shall be a pillar to the Lord, at the border of Egypt, and it shall be for a sign and a witness to the Lord of Hosts." (See Isaiah 19, 19-20.) The question is often asked, "What was this pyramid built for?" Who knows but the correct answer to this question is contained in this prophecy? If it was built under Divine guidance, to prove that the God of Revelation is the God of true science could the language of prophecy have been framed so as to fit it better? Even to its exact location, it is literally just *at* Egypt's border.

Gardner Wilkinson, in his "Hand Book of Egypt," says, "Ancient Egypt included only the valley of the Nile." The adjoining desert was not regarded as a part of it any more than is the Mediterranean Sea regarded as a part of the Atlantic Ocean. The line which defines the *boundary* of Egypt is so marked between Egypt and the Desert that a person may step from one to the other."

And is it any more incredible that Chronology, full-grown and mature, should demand rooms beforehand in that enduring pillar, while in process of erection, where he could tarry and bear witness that Revelation and *true* Chronology are in harmony—is this any more incredible than that his elder brethren, Astronomy and Mathematics, venerable with myriads of cycles, should be on hand and direct in its perfect construction, and then, like mighty giants, straddle and surround it and wait there, themselves, through the ages, till their testimony, in favor of *pure* Astronomy and *pure* Mathematics is received and acknowledged? We fail to see how, if we admit the one, we can fairly be charged with *credulity* in admitting the other. But the *one* we *must* admit! It has been mathematically demonstrated! We cannot demonstrate Chronology as we demonstrated Mathematics any more than we can morals. Future chronological events we must decide upon, as we decide upon the future rising of the sun, by its regularity in the past. Is this fair? Unless, then, we can show that the so-called time-tables have heretofore marked beforehand important events, as they occurred, we will not pretend that it is reasonable to believe that they will do it in the future. But suppose they have invariably marked important events correctly (before they occurred) thus far, is it unreasonable to expect they will do it in the future? Say, skeptic! What objection is there to this rule for testing a future chronological chart?

We are aware that this theory opens a new field of investigation for scientists—one at variance with preconceived notions and prejudices—a field that is particularly inviting to the visionary and superstitious, and which sound logicians, if obstinate, are likely to shun on that account.

That the sciences of Astronomy and Mathematics are there in their modern garb is plain. We have seen here accurate measurement of great distances, and a division of symbolical astronomical circles so as to divide time correctly. We have seen also among the measures of the pyramid, a scale, with an inch representing a year, applied in marking the precise duration of the precessional period.

Now we will examine the claims that history, before its occurrence, chronologically arranged, is symbolized in its avenues and internal arrangements:

When you put intricate machinery together, so that it exactly fits, the probability is that you have put it together aright. For example, a watch would not run unless it was put together aright. Our English ancestors when they recorded deeds of conveyance, duplicated them, placing one on each end of a single parchment. Then these were cut apart on indented lines; that is, lines like saw teeth. The fitting of these two pieces of parchment together was proof, equal to a seal, of their genuineness; hence the origin of the word indenture for deed. The proof of chronology, like that of prophecy is in the occurrence or denting of the described events into the specified dates. For example, a British lord once rudely asked—

His valet if he knew
An argument or fact to prove
His cherished Bible true?
The terms of disputative art,
He had not learned to use,
So pointing to a synagogue,
He said, "My lord! THE JEWS!"

Jewish history, anomalous as it is, exactly fits or dents into Jewish prophecy!

Now this is all that there is to the claim concerning the pyramid's chronology of future events, the wonderful fitting or denting of one into the other. That some of these fittings may be mere coincidences, we do not deny. But to believe they all are, it seems to us would require more credulity than to believe they are not. Such a combination of wonderful accident would be more marvelous than the realities.

Now let us examine this fitting of corresponding records which are independent of each other. And we will begin with the earliest historical event plainly recorded in hieroglyphics on any of the old Egyptian monuments, corresponding with the same event as recorded in Scripture. This was the plundering of Solomon's temple by Shishouk I, of the 22d Egyptian dynasty. This event is sculptured unmistakably on the walls of the temple of Karnac in Upper Egypt. Champollion, on entering this temple, saw at a glance a hieroglyphic description of a triumph, where the captives were plainly Jewish in their features, and where "Melek Aindah," King of Judah, was sculptured out so conspicuously that it could be interpreted as readily as on the day when it was put there. The scripture account of this reads thus, see 1 K., 11:40:

40 Solomon sought therefore to kill Jeroboam. And Jeroboam arose, and fled into Egypt, unto Shishak, King of Egypt, and was in Egypt until the death of Solomon.

And 14; 25, 26:

25 ¶ And it came to pass in the fifth year of king Rehoboam, *that* Shishak, King of Egypt, came up against Jerusalem:

26 And he took away the treasures of the house of the LORD, and the treasures of the King's house; he even took away all; and he took away all the shields of gold which Solomon had made.

[See, also, 2 Chron. 12; 2–11.]

Here are corresponding records that dent in, or fit together, as to the events, so as to prove beyond doubt, their occurrence. They also prove conclusively that Solomon and Shishon I, were contemporary, and that Solomon's temple must have been built during the 22d dynasty, when Egypt was at the climax of her prosperity and power. But the exact date before the Christian era that this event occurred, is not so easy to determine. The foundation of Solomon's temple was laid probably between 1010 B. C., and 1027 B. C. Pool places it in his chronology, at 1010 B. C.; Usher at 1012 B. C.; Bunsen at 1024 B. C.; Hales at 1027 B. C. Here is a difference of seventeen years in the extremes of these calculations. This is as near as we can arrive to the date of this event, from any of the sources here quoted.

The earliest symbolical record of any event found on any monument on the earth, corresponding with a similar record found in profane history, is that of the erection of the great pyramid by King Cheops of the 4th Egyptian dynasty, whose signature is still in existence on a monument of his own erection. Osborn fixes this date, historically, at between 2108 and 2228 B. C., and Wilkinson at between 2089 and 2123 B. C. The astronomers Herschel, Smith, and others, after obtaining the approximate date of its erection, historically found it necessary to adjust this date so as to correspond with the fact of its facing exactly the four cardinal points. Such perfect orientation they concluded could not possibly have been obtained at that day (long before compasses were invented) without the aid of a star, exactly south, in connection with the one at the North pole. The time of erection thus adjusted by them, was determined at 2170 B. C., when the stars Alpha Draconis, and Alcyone were exactly on the same celestial meridian, one north, at the pole, and the other south, at the equator, at mid-night, and coincidently with the vernal equinox. Here is a historical date corrected and regulated by the signs of the zodiac, or the great clock of the ages, which is reliable. And it is said that this *historical* date so adjusted, corresponds exactly with its own *monumental* date, which we will soon explain.

Here we have two points of time established with reasonable definiteness, one at about 1020 B. C., and the other at 2170 B. C. Between these dates there is an interval of 1150 years, which is covered entirely over by 18 Egyptian dynasties from the 4th to the 22d inclusive, making an average of only 65 years to a dynasty. Considering there are only three more dynasties previous to these, is it not rather extravagant to speak of Egyptian dynasties extending over tens of thousands of years? One writer, determining not to let the fashion of the age get ahead of him, has made out on paper 300,000 years of civilized life in Egypt before the creation of the pyramids. I ask, in the light of what we have proved from the pyramid of Cheops and Solomon's temple concerning the average length of Egyptian dynasties, if the Bible account of the first settlements in Egypt is not the most rational of any. Egypt in Hebrew is called Misraim. What more reasonable than that Misraim, the grand-son of Noah, was its founder, and that his son Copt was the ancestor of the ancient Copts? Sir Gardner Wilk-

inson says, that Egypt is called Arabac Misr., from Misraim, the second son of Ham, which in Coptic is spelled Chme. He adds, that tradition has it, that Ham had a fourth son called Copt, who conquered all Egypt and gave it his name. (See hand-book of Egypt.)

Egypt has very properly been called the monumental land of the earth, as the Egyptians were the monumental people of all history. It is the first country that has a history. If, then, as is admitted, monumental history is more reliable than all other, ought not this most effectually to dispose of those extravagantly long and fanciful periods (which some speaks of as existing) before the Pyramids? Do you ask, Why? We answer, Because there are none of those "most reliable of all evidences" (monuments) to prove it.

We have now examined in order the evidence from Geology, Astronomy and Stone Monuments, as gathered by the most profound scholars the world has ever produced, in order to learn Chronology from the Egyptian stand-point. No one pretends that there is any better place than Egypt to obtain the information desired. We have been enabled to explore back far beyond the origin of written language as expressed by letters. Lord Bacon has said: "Hieroglyphics preceded letters." May we not add with propriety, they were letters in embryo, and preceded written words, as "coming events cast their shadows before." These hieroglyphics were of three varieties: 1st, Those which symbolized objects; 2nd, Those which symbolized ideas; and, 3rd, Those which symbolized sounds. Our ablest scholars tell us that these Egyptian hieroglyphics and symbols antedate the most ancient of all languages ever written by human beings; that they are older than any book in China or India; older than the Zend of the Persians, the Vedas of the Brahmins, or the Sanscrit of the Hindoos. To all of these languages, therefore, there is a limit in their age, and we are able, from the stand point taken, to determine approximately what that limit is. Now there is no difficulty in determining relatively the date of this oldest of all monuments—the Great Pyramid. It carries its own evidence with it in King Cheops' signature that it was built in the fourth dynasty. But to determine exactly how many years before the Christian era this occurred, is quite another matter.

Prof. Smyth claims to be able, however, to determine very closely this date in two ways. The first is by the precession of the equinoxes, which we have already explained. The other is by the interpretation of symbolical marks, on what he considers a historical time table. But how can time for 4,000 or 5,000 years, including the epochs and history of Judaism and Christianity through 1542 years of the one and 1881 years of the other, be symbolized? How can this be done so as to agree with the Bible history of the same, including character? Is such a thing possible? Let us see! A lifetime has been charmingly symbolized under the figure of a highway, with its ups and downs, etc., in that inimitable allegory by Dr. Johnson, entitled "The Journey of a Day the Picture of Human Life."

What is the beautiful allegory of Bunyan, but religious history symbolized in roads marked so plainly that any one can interpret the symbols? Here is

the destination of one class. There is the destination of another class. Here is the wicket-gate; there is the Slough of Despond. Up there are the Delectable mountains. What was the journey of the Hebrews, from Egypt to Canaan, but one grand symbol of pure Christianity?

If you were to show a traveler the way to some distant point, which to him is all in the future, would you not trace out for him on paper, symbolical roads, marking objects of interest on his way, at commensurate distances, to the end of his journey? We have been accommodated many times by such symbolical highways, marked out for us by some obliging guide, and we have found them reliable.

Well, the first crucial test of Prof. Smyth to prove that the avenues in this structure (which of itself is a symbol of our earth) symbolized chronological periods, was made in applying his measuring scale (of an inch to a mile) to the date of its erection. To his astonishment, it matched it exactly, (see figures.) It *dented* right in, at 2,170 inches north of the beginning of the grand gallery. And right there, within an inch of that measurement, were perpendicular (erect) lines, cut in both walls, from top to bottom, as if to attract attention to that spot. Then, to add emphasis to this symbol of erection, the stones here were erected, from their usual inclined position at right angles with the slope, to a perpendicular (erect) position as much as to say, "Attention! traveler! erection right here!" Could an erection be symbolized more effectually than by erecting something? The act of building is now one definition of erection; and might not the act of building the great pyramid be symbolized by a sign signifying erection before written words had been invented?

These erect lines and erect joints mark a distance from the entrance of three hundred and fifty-seven inches. No landmark was ever more permanently established than was this one first established mile-post on our journey through this symbolized earth. It is as plain to-day as when put there over five hundred years before the birth of Moses.

Now it is claimed that this erection or "act of building" occurred 628 years before the exodus of the Jews. Exodus signifies departure; and right at the 628 inch mark, south of the established sign-post, labeled "Erection," we find the first departure or (Exodus) in the road. The symbolized sign-post here reads, "Exodus" as plainly as the preceding one read Erection. Like a voice from a friendly guide, it says: Pilgrim! Look here! Exodus right here! A new departure here. See! It is an up-hill road, rather steep! At the same angle upward that the road we left was downward.

As in Bunyan's symbolical travels, there is but one place of beginning; where all mankind start on life's journey; so it is here. But like that also, there are two places of destination, one below, and the other above. At the start, all go as the dragon (Alpha Draconis) points, one way, which is a downward, slippery road, that ends in a filthy, unventilated, unfinished cellar or vault, patterned after a tomb, far beneath the earth's surface, where total darkness reigns supreme. The avenue thither is only about four feet high, (47.3 inches and 41.5 wide. So

a traveler on this road is compelled to go with his back painfully bent, as though pressed downward with a heavy load, without the possibility of either rest or comfort. But after proceeding to the second sign-post, marked 'departure' or (Exodus), one whole nation turns off the old road under "Divine guidance," and proceeds upward, where climbing takes the place of sliding, but where the passage-way continues equally contracted as the other, and furnishes no rest for the weary. The destination, however, at the end of this road, is in wonderful contrast with the destination of the other. It ends at the ante-room, or entry to a spacious chamber, with most beautiful red granite walls, polished like the finest jewelry, of the most exquisite workmanship. The only article of furniture which it contains is a magnificently wrought red granite chest, without lid, corresponding in capacity, exactly with the ark of the covenant of Moses, and exactly $\frac{1}{100000}$ of the size of Noah's ark. One quarter of the capacity of this chest corresponds exactly with the one-quarter grain measure of Great Britain. This room is so situated and so ventilated with fresh air, by two large tubes, that the atmosphere is neither too cool nor too warm, about 68° Fahrenheit, (50° of its own Thermal measure,) and never changes. This chamber so symbolized of beauty and perfection, comfort, is farther above the earth's surface than the unfinished dismal vault at the end of the other road is below it.

Now, why is not this as good a symbol of religious history as "Bunyan's Pilgrim's Progress?" These avenues and internal arrangements mean something. Let any one who can, give a better interpretation of them. We do not insist, at this early stage of our investigation, that we cannot possibly be mistaken. But we do say now, that the coincidences are marvelous, and in harmony with the other marvels already considered.

Freemasons have told us that among their very ancient symbols, a man erect was a symbol of what? Of perfection! Now in these symbolical roads there is no place where a man can stand erect till he symbolically is in Christ. It certainly agrees with Scripture that no perfection can come by the Mosaic ritual, and that the Jewish code never made a person perfect. [See Heb. 7., 19.]

Now let us follow Judaism from their exodus sign-post 1542 inches, for the 1542 years of their history, till we reach the Christian era, and what do we find then at this new epoch in history, both sacred and profane? Evolutionists and Deists, Jews and Christians, all acknowledge the historical event of the birth of Christ every time they date an account! What does A. D. 1878 mean, if not that the Christ of the Bible is the Christ of history, and that his birth marked an historical epoch? Now right here what do we see? A great and sudden expansion in the road; not side-ways! It is no broader than before. But it does expand upward; toward Heaven! It is exactly seven times higher than before, and walled with exactly seven courses of over-lapping stones on each side. A person need not go bent down any longer, as though carrying a heavy load. He can now stand erect and walk erect if he choses, till he reaches the very entrance to his destined abode. If you were to try your hand at an effort to symbolize man's natural downward tendency and end, with Judaism and Christianity as

scriptually described, do you think you could improve on their peculiar symbolical arrangements of the pyramid of Cheops? They were put there for some purpose, and in other pyramids. What was that purpose? We have answered this question in one way. Let us have a better explanation, if possible. Who will instruct us as to what all these symbolical roads and rooms mean?

But we have not done yet with these religious symbolisms. At this point representing the commencement of the Christian era, just where the road becomes inviting and pleasant, the Jewish nation fly the track, and take a new departure. Now, they neither incline upward nor downward, but go earthward, horizontally, on a road which also ends in a room not to be despised, although far inferior to the one above. This room is on the 25th course of masonry. Could you symbolize Jewish history since the epoch of Christianity in any better way than this? What does the room at the terminus of their horizontal earthward road symbolize, but the earthly wealth and aggrandizement which they have already reached at as their climax of desire to worldly prosperity? This, too, is strictly in accordance with their choice and Bible prophecy, concerning this wonderfully anomalous race. Whether the well on this last route signifies their sinking under the Roman power to rise again in a spiritual sense, at the prophetically appointed time, or whether it has any other symbolical meaning, we are not prepared to say. We are not fully satisfied that we understand at all the symbolical signification of this well. That it represents the resurrection of Christ, appears to us fanciful.

Now, here is a structure situated among idolaters and built by idolaters. Their other monuments are all covered over with symbols of their idolatrous forms of worship. But this one contains no allusion to any religion except Judaism and Christianity. What does this wonderful fact mean? Herodotus obtained from Egyptian priests a tradition that King Cheops suspended idol worship, closed the idol temples and forbade the offering of sacrifices to idol gods, during the erection of his pyramid. The reason suggested by some why Cheops was not buried there, was, that he so incensed the idolatrous natives by his prohibition of idol worship, during the erection of the pyramid, that they would not permit it.

Now, if it be asked what reason we can give for using one inch to a mile rather than ten or one hundred, in these measures, we answer: First, because it fits; secondly, it is the measure which we have shown was used before on this level. The distance around the pyramid on this fiftieth course of masonry is 25.827 inches. The circle described by using the vertical height from this point as a radius is, in length, 25.827 inches. This is the number of years that the pyramid's governing star, Alcyone, will be in performing its grand cycle on the ecliptic, twenty-five thousand eight hundred and twenty-seven years.

We have never examined the symbol in the internal arrangements of the pyramid of Cheops, bearing on Chronology. There are others which we must defer till another time. We are aware of the liability to interpret erroneously this kind of language; we may think we find symbols where there are only coin-

cidences. Bunyan undoubtedly made mistakes in his interpretation of some of the symbols of Solomon's temple. The most intelligent expounders of the Scriptures differ widely in their intepretations of the most significant symbols of the New Testament, (Baptism and the Lord's Supper). We remember a temperance lecturer who said that the reformation of John the Baptist was the reformation of drunkards: because inebriates walked crooked and when reformed walked straight—this man of one idea thought he saw in John's "walking straight paths" a symbolism of the reformation of drunkards. Prof. Smyth is charged with weakening the authority of his symbolical discoveries by some fanciful theories which are only hypothetical. The attributing to Melchisedek the architectural superintendency of the pyramid's erection is one; this he has since retracted. Then these last chronological monuments do not exactly agree with the chronological charts which we have been in the habit of consulting. The year A. D., 1881, will end about 1881 years from Christ's birth, but not from the exact, true historical epoch of Christianity as we understand its history. (See Luke 16, 16.) We hope the distinguished professor will explain.

We all need to be cautious when traveling new roads in the dark, lest, by endeavoring to avoid a ditch on the one side, we are plunged into a slough on the other. The advice given by an able expounder of symbols, in old times, is as good now as ever: "Prove all things. Hold fast that which is good."

ANCIENT OLLA MANUFACTORY ON SANTA CATALINA ISLAND, CALIFORNIA.

During my explorations along the Pacific coast I paid much attention to the discovery of the workshops of one of the most beautiful articles of true aboriginal workmanship. It is the *olla*, a cooking vessel made of a species of steatite, the pot stone, or *lapis ollaris*, of old, of which Theophrastus and Pliny speak as a material used for the manufacture of vessels among the ancient eastern nations. My observations and notes, which I made while working on the mainland, pointed to the islands in the Santa Barbara channel as the locality in which the munufacture was carried on. I expressed the opinion in my report to the Smithsonian Institution (Hayden's Bulletin, Vol. iii, p. 50), that the site must be looked for on Santa Catalina island. During my last year's visit to that island, on behalf of the Peabody Museum, I discovered the first quarries in the locality called Pots valley. The pits and quarries revealed the busy hand of the aborigines, among the *debris*, and in the partly-covered pits where cooking vessels were found in all stages of finish, from the boulder, but partly worked out from the rock and still firmly attached to it, the globular form roughly rounded, the boulder in which the excavation has already been commenced, and so on to the smoothly finished pot. All the implements with which the task was accomplished were also found, and, by observing the progress of the work in the many specimens discovered, it was not difficult to ascertain the mode of manufacture, the result of which I made the

subject of an essay accompanied by illustrations (Report of the Peabody Museum, 1877).

Not only were cooking vessels extensively manufactured on this island, but also flat dishes (which the Mexicans call *Coniales*), cups, pipes, stone rings which were used as weights for digging-sticks, and all kinds of trinkest. These articles constituted the money of the people of Santa Catalina, like the shell beads of the neighboring island of Santa Cruz, where they were extensively manufactured by the aboriginies, and whence they were distributed far along the coast, and, to some extent into the interior. The quarries are more abundant in number towards the south-eastern end of Santa Catalina, where for about two miles square not less than three hundred quarries and pits were discovered, during my last visit, with a large number of pot-boulders, sherds, tools, etc.—*Paul Schumacher.*

GEOGRAPHY.

CONGRESS AND THE NORTH POLE.

AN ABSTRACT OF ARCTIC LEGISLATION IN THE CONGRESS OF THE UNITED STATES.

BY CAPT. H. W. HOWGATE, U. S. A.

II.

THE SECOND GRINNELL EXPEDITION.

Immediately upon the return of DeHaven, Mr. Grinnell, the owner of the vessels which formed his expedition, generously offered them for another cruise in search of Sir John Franklin, if Congress should think proper to authorize it. Congress did not accept this offer, and Mr. Grinnell placed one of them—the Advance—at the disposal of Dr. Kane, who, at the solicitation of Lady Franklin, had been authorized by the Secretary of the Navy to lead a new American expedition in search of her lost husband.

The expedition was a private one, so far as outfit was concerned, Mr. Peabody, of London, contributing largely for this purpose. In addition to Dr. Kane, ten of the party belonged to the U. S. Navy and were attached to his command by orders from the Department, and without special legislation in either case. Dr. I. I. Hayes, subsequently distinguished in the same field of exploration, was attached to the vessel as Surgeon.

The following extract from the Annual Report of the Secretary of the Navy,

under date of Dec. 4, 1852, gives the official record of his action in the matter:—

* * * * * *

"Lady Franklin, whose devotion to the cause of her unfortunate husband has excited so large a sympathy in the United States, has been encouraged to make another effort to determine the fate of the gallant navigator of the Arctic seas, and is now intent upon the organization of a new expedition, under the auspices of our countrymen, Mr. Henry Grinnell, of New York, and Mr. George Peabody, of London. * * * * *

The distinguished lady, whose sorrows have inspired this zeal of adventure and whose energy has given it an intelligent and hopeful direction, has done no more than justice to a meritorious young officer of our Navy, Passed-Assistant Surgeon Kane, in asking his co-operation in this hazardous expedition. * *

The request of Lady Franklin, to enlist Dr. Kane in the new expedition has been handed to me and I have not delayed to give him the necessary permission and to confer upon him all the benefit he may derive from his position in the Navy by an order which puts him upon special service.

If it should become requisite in the field of operations to which he is destined to provide him with the means for the prosecution of scientific study beyond those which may be afforded by the Department and the liberality of the distinguished gentlemen who have assumed charge of this expedition, I would commend it to the enlightened regard of Congress with the most confident hope that that body will respond to the suggestions of this necessity with a prompt appreciation and generous support of an undertaking so honorable to humanity and so useful to the enlargement of liberal science." * * * *

Dr. Kane's assignment to duty in connection with the expedition was issued in November, 1852, as follows:

NAVY DEPARTMENT, WASHINGTON, D. C., November 27, 1852.

SIR:—Lady Franklin having urged you to undertake a search for her husband, Sir John Franklin and his companions, and a vessel—the Advance—having been placed at your disposition by Mr. Grinnell, you are hereby assigned to special duty for the purpose of conducting an overland journey from the upper waters of Baffin's bay to the shores of the Polar seas.

Relying upon your zeal and discretion, the Department sends you forth upon an undertaking which will be attended with great peril and exposure. Trusting that you will be sustained by the laudable object in view, and wishing you success and a safe return to your friends, I am, respectfully, your obedient servant,

JOHN P. KENNEDY, *Secretary of the Navy.*

Passed-Assistant Surgeon, E. K. KANE, *U. S. Navy.*

In February the scope of his duties was enlarged by the following additional instructions:

NAVY DEPARTMENT, February 9, 1853.

SIR:—In connection with the special duty assigned to you by the order of this Department, bearing date Nov. 27, 1852, your attention is invited to objects of scientific inquiry, particularly to such as relate to the existence of an open

Polar Sea, terrestrial magnetism, general meteorology and subjects of importance connected with natural history.

JOHN P. KENNEDY, *Secretary of the Navy.*

The expedition sailed from New York, May 30, 1853, and reached Upernavick, in Greenland, July 24, and Dr. Kane's report of his arrival at this place was the last tidings received of him or his party for more than two years, during a portion of which time they were mourned as sharers of Sir John Franklin's fate.

In the fall of 1854 the friends of the missing navigators became alarmed at their long absence and took steps to have a naval vessel sent in search of them. As this required legislation, application was made to Congress for the necessary authority, and December 18, 1854, Mr. Brodhead, of Pa., submitted for the consideration of the Senate the following resolution:

Resolved, That the Committee on Naval Affairs be instructed to inquire into the expediency of sending a steamer and tender to the Arctic seas for the purpose of rescuing or affording relief to Passed-Assistant Surgeon, E. K. Kane, of the United States Navy, and the officers and men under his command.

On the 19th the Senate proceeded to consider this resolution, and the following extracts are made from Mr. Brodhead's remarks in its support:

* * * * * *

"Lady Franklin urged him to take command of another expedition in search of her husband; Mr. Grinnell gave his tried vessel, the Advance; Mr. Peabody of London gave $10,000; and Dr. Kane used his exertions as a lecturer and his influence with different scientific institutions to make up the rest. He had, however, succeeded but partially, when Mr. Kennedy, the then Secretary of the Navy, took an important part in consummating the scheme. He gave Dr. Kane orders, as a navy officer, to take command of the expedition, assigned to him the services of several warrant officers and seamen, provided hospital and other stores, astronomical and nautical instruments, &c., &c., furnished the vessel with a library, and finally ordered Dr. Kane to report fully to the Department on his return. The cause of science was thus to be advanced by governmental aid. *

* * Dr. Kane is a gallant officer, conducting a hazardous and meritorious enterprise with the consent and under the orders of the government, and hence it becomes the duty of a generous Government, representing a generous people, to take measures for his rescue or relief. We have officers and men unemployed; officers have already volunteered and there will be no difficulty in procuring men of the best sort, and I therefore hope the resolution will be adopted."

There was no opposition, and the resolution was adopted without discussion.

On the same day—December 19th—Mr. Fish, of New York, presented the memorial of James Brown and others, of New York, praying that an expedition be sent to the Polar seas for the purpose of affording relief to Dr. Kane, his officers and crew; which was referred to the Committee on Naval Affairs.

In the Senate, January 10, 1855, Mr. Brodhead called up the matter and said:

The Committee on Naval Affairs to whom were referred memorials from the Chamber of Commerce, New York; from James Brown and others, of New York; from the Board of Trade, of Philadelphia; from the Board of Trade, of Boston; from the Life Saving Benevolent Association, of New York; from the Marine Insurance Companies of New York; from the American Philosophical Society, of Philadelphia, and others, asking Congress to extend relief to Passed Assistant Surgeon Kane, have instructed me to report a joint resolution respecting the Arctic Expedition, commanded by Dr. Kane."

The joint resolution was read a first time, and ordered to a second reading.

Mr. Brodhead urged immediate consideration, but objection being made by Mr. Badger, it went over.

SENATE, January 15th, 1855.

On motion of Mr. Brodhead the joint resolution was taken up, and after a brief discussion passed with an amendment, providing that the steamer and tender should be officered and manned by volunteers from the Navy and others who may declare their willingness to be so engaged.

Previous to the vote: Mr. Hunter, of Virginia, expressed a doubt as to the propriety of the proposed expedition, as probably involving the government in an endless series of expeditions.

Mr. Mallory, of Florida, in reply, gave a brief statement of Dr. Kane's plans, which included provision for such an emergency as had actually arisen, showed that the object of the proposed expedition could be accomplished in a few months without serious risk or loss.

In the House of Representatives the friends of the missing ones had not been idle, as the following record shows:

DECEMBER 11, 1854.

Mr. Florence, of Pa., asked consent to offer a resolution providing for an expedition for the relief of Dr. Kane, but objection was made by Mr. Jones, of Tennessee, and the resolution was not received.

DECEMBER 14.

Mr. Wheeler, of New York, introduced a memorial on the subject from the Chamber of Commerce, of New York, which was sent to the Committee on Naval Affairs.

JANUARY 22d, 1855.

Mr. Pennington, of New Jersey, presented a memorial in favor of the Kane relief expedition, from the Governor of New Jersey and the State Legislature, which was referred to the Naval Committee.

Mr. Chandler, of Pennsylvania, asked consent to take from the Speaker's table the Senate joint resolution, and called attention to the necessity of speedy action.

Mr. Smith, of Virginia, objected and the matter went over.

JANUARY 25th, 1855.

Mr. Chandler, of Pennsylvania, again tried to get the resolution from the Speaker's table, but objection was made by Mr. Millson, of Virginia.

JANUARY 29, 1855.

The Speaker laid before the House a communication from the Governor of Pennsylvania, transmitting copy of a resolution adopted by the Legislature of that State, in favor of an expedition to rescue Dr. Kane and his crew.

Mr. Florence moved its reference to the Naval Committee, when Mr. Chandler again asked that the Senate joint resolution be taken up, and after some discussion the rules were suspended, and after an eloquent statement from Mr. Chandler of the circumstances under which the relief was rendered necessary, the resolution passed, in the following words.

Resolved, By the Senate and House of Representatives of the United States of America, in Congress Assembled:

That the Secretary of the Navy be and he is hereby authorized to provide and dispatch a suitable naval or other steamer, and if necessary a tender, to the Arctic Seas, for the purpose of rescuing or affording relief to Passed Assistant Surgeon E. K. Kane, of the United States Navy, and the officers and men under his command;

Provided, That such steamer and tender shall be officered and manned by volunteers from the Navy and others who may declare their willingness to be so engaged.

(Approved February 3d, 1855.)

Money was now needed to fit out the search expedition, and this was speedily provided, as the record shows that in the Senate March 3d, 1855, the Naval Appropriation Bill being under consideration, the following amendment was offered by the Committee on Finance and adopted:

"To enable the Secretary of the Navy to carry into effect the joint resolution respecting the Arctic Expedition commanded by Passed Assistant Surgeon E. K. Kane, or so much thereof as may be necessary—$150,000."

The time for preparation was limited; but with the aid of energetic officers and the active and praiseworthy co-operation of the naval contractors and mechanics at the navy yards of Brooklyn and Philadelphia, two small vessels were admirably and rapidly fitted out.

Excellent officers volunteered—good seamen enlisted—complete supply of provisions and clothing for two years of rough exposure was laid in, and on the 4th of June the little party of brave and philanthropic adventurers left New York Harbor, amid the encouraging cheers of their countrymen, who knew so well how to appreciate such acts of daring and humanity. The expedition consisted of two vessels—the barque Release, and steamer Arctic—and was commanded by Lt. Henry J. Hartstene, U. S. Navy, who received the following instructions for his guidance:

NAVY DEPT., May 25, 1855.

SIR:—A resolution of Congress, approved Feb. 3, 1855, authorizes the Secretary of the Navy to provide and dispatch a suitable naval or other steamer, and if necessary, a tender, to the Arctic seas, for the purpose of rescuing or affording

relief to Passed-Assistant Surgeon, E. K. Kane, of the United States Navy, and the officers and men under his command.

The barque Release and steamer Arctic, having been procured, and especially fitted and equipped for this service under your supervision and inspection, with full rations and extra provisions for two years, and clothing peculiarly adapted for the climate of the Arctic region, and such officers and men detailed as the department, as well as yourself, considered necessary and sufficient, and the command of the expedition having been already assigned to you, you will, so soon as the above named vessels are, in all respects, ready for you, proceed with them, by all means as early as the first of June, in the prosecution of the object of the resolution of Congress. Economize as much as possible in the way of coal. * * * * * * *

J. C. DOBBIN, Sec'y. of Navy.

The following named officers of the Navy were attached to the vessels of the expedition:

TO THE "RELEASE."—Commander H. J. Hartstene, Commander of the Expedition; Lieutenants, William S. Lovell, and Joseph P. Fyffe; Assistant Surgeon, James Laws, and Boatswain Van R. Hall.

TO THE "ARCTIC."—Lieutenant Commander, Charles C. Simms; Lieutenant, Watson Smith; First Assistant Engineer, Harman Newell. Dr. John K. Kane, brother of the explorer, was attached to the Arctic as Medical Officer.

The story of their achievements and the successful relief of Dr. Kane and party, is briefly but eloquently told in the report of the Secretary of the Navy, J. C. Dobbin, as follows:

* * * * * The recital of their hair-breadth escapes, their terrible conflicts with nature, which seemed to mock their efforts—their alternations of sad misgivings and sustaining hopes, impart truly an air of romance to this unostentatious exhibition of genuine heroism. In about four months with their little barques, they sailed *eight thousand miles*, fully circumnavigated Baffin's Bay, passed further north into Smith's Sound at the northern boundary than any one save Dr. Kane, and nearly to Beechy Island—visited a village of Esquimaux, from whom, after hours of difficulty, by means of signs and drawings, they learnt the point to which Dr. Kane and his party had directed their course—immediately changed their route, found the unhappy party at Disco Island, and returned them in safety to their country and friends—thus accomplishing the benevolent purposes of Congress."

The relief expedition reached New York on its return, October 11th, 1855.

In the House of Representatives, March 7, 1856, Mr. Tyson, of Pennsylvania, on leave, presented resolutions passed by the Legislature of Pennsylvania, of thanks to Dr. Kane and his officers and crew for the successful result of their recent expedition to the Polar region, which were laid on the table and ordered to be printed.

March 11, 1856, Mr. Tyson, by unanimous consent, introduced the following preamble and resolution, which were read, considered and agreed to:

WHEREAS, The intrepid conduct and scientific zeal of Dr. Elisha Kent Kane in his late expedition to the Polar regions in search of Sir John Franklin, aided by the officers and men under his command, have placed his name in the first rank among Arctic explorers; and,

WHEREAS, The observations and discoveries he has made are important additions to geographical and meteorological science, and valuable in the light which they shed upon the currents of the ocean; upon the mysterious changes in the magnetic needle, and upon the physical laws of this globe; and

WHEREAS, The narrative of these heroic labors and their magnificent results, should be widely diffused as well to encourage the spirit of scientific research among our countrymen as to express the profound sense we entertained of the merits and services of the explorer; therefore,

Resolved, That the Committee on the Library be instructed to inquire into the character of the book about to be issued by Dr. Kane, as to letter-press, illustrations, and binding, and report their opinion of the expediency of ordering a certain number of copies thereof for use and distribution.

The attempt to connect the Government with a private firm in publishing an unofficial narrative of a prlvate expedition, was unsuccessful, as will be seen from the following extracts from the *Globe*.

APRIL 16, 1856.

Mr. Tyson, from the Library Committee, submitted a report on the resolution for the purchase of Dr. Kane's Narrative, and recommended the purchase of fifteen thousand copies for the use of Congress; also recommending that medals be struck and presented to Dr. Kane, his officers and men, respectively, as an expression of the high estimation in which Congress held their merits and services. After a long discussion, in which considerable feeling was manifested, the resolution was passed as reported.

SENATE—March 12, 1856.

Mr. Bigler, of Pennsylvania, presented the resolution of the Pennsylvania Legislature, and moved their reference to the Committee on the Library, with instructions to inquire into the expediency of purchasing for the use of the Senate a certain number of copies of Dr. Kane's Narrative, to be published in Philadelphia. In the course of his remarks upon the resolutions, Mr. Bigler said:

* * * * * "The feats of the most daring on the field of battle are not better calculated to touch the chords of the American heart, and to command general admiration, than the startling discoveries and thrilling adventures incident to the career of a daring navigator and explorer. The feeling is peculiarly strong with an enterprising and progressive people.

* * * * * * * * * *

"The Royal Geographical Society of England has by resolution assigned to him a front rank among Arctic explorers. It has also in store for him, as I learn, a personal compliment in the shape of a gold medal. The French Government, also, ever magnanimous in its recognition of genius and courage, and generous in its patronage of the arts and sciences, has congratulated the Doctor on his triumphs. The Legislature of Pennsylvania, Kane's native State, have

thanked him for the honor his career has conferred upon her people. The Legislature of New York, by unanimous consent, have evinced their estimate of the expedition by presenting its leader with a gold medal. Complimentary resolutions have also been passed by the Legislatures of Maryland and New Jersey.

* * * * * * * * * *

"Some of the ancients we read honored civilians as well as soldiers, and surely in no age, ancient or modern, should the daring navigator and discoverer command less of his country's admiration and bounty. The brave man who plants the flag of his country in the enemy's camp, is worthy of distinction, but not more so than he who extends the limits of civilization and human knowledge at the risk of life and the loss of health and comfort. The most desperate in battle do not evince a higher degree of true courage.

* * * * * "They are entitled to the gratitude and admiration of the whole human race, and will be to the end of time."

* * * * * * * * * *

Mr. Seward, of New York, submitted a substitute for the resolution, which was accepted by Mr. Bigler and read as follows:

Resolved, That the Committee on the Library be instructed to purchase, for the use of the Senate, ten thousand copies of Dr. Kane's Narrative of his late Expedition to the Arctic regions, from Messrs. Childs & Peterson: Provided the price shall not exceed five dollars per copy.

Mr. Brodhead, of Pennsylvania, suggested an amendment, that if the Committee found the work to be a useful one, and yet not consider it expedient to purchase an unofficial book, a bill be reported authorizing a direct money payment of $10,000 or $20,000 to Dr. Kane. He doubted the propriety of going into partnership with any publishing firm in the United States, and cited the amount voted Commodore Perry for his services in the Japan Expedition as a precedent.

Mr. Bigler stated that Dr. Kane felt a delicacy in appearing before the country as a claimant for pecuniary reward, and hence he thought the plan indicated by the resolution the best.

After a brief discussion the subject, on motion of Mr. Seward, went over until next day.

SENATE, March 13, 1856.

The consideration of Mr. Brodhead's amendment was renewed and discussed at length without any definite result, and it was again postponed.

SENATE, March 24, 1856.

Mr. Seward called up the resolution concerning Dr. Kane, and his substitute was adopted, as follows:

Resolved, That the Committee on the Library be instructed to inquire into the expediency of some legislative recognition of the eminent services and success of the recent expedition of Dr. Kane to the Arctic regions.

SENATE, April 18, 1856.

The joint resolution for the purchase of Dr. Kane's forthcoming work, and

for the presentation of medals, was read twice and referred to the Committee on Library.

SENATE, August 11, 1856.

Mr. Pearce, of Maryland, from the Committee on the Library, reported back the resolution for purchase of books and presentaton of medals, with an amendment and a written report, and asked immediate consideration, unless debate was likely to ensue. At the request of several Senators it went over, and the report was ordered to be printed.

SENATE, August 18, 1856.

The joint resolution was reached on the calendar, and on Mr. Clay's motion its consideration was postponed until the second Monday in December.

SENATE, Dec. 18, 1856.

Mr. Pearce called up the joint resolution and stated that the recommendation of the Library Committee which had it in charge was to strike out the clause providing for the purchase of 15,000 copies of Dr. Kane's work, and retain only the clause to provide medals. The title was changed to correspond with this recommendation and it passed as amended without debate.

HOUSE OF REPRESENTATIVES, March 3, 1857.

On motion of Mr. Tyson the House passed the joint resolution awarding medals to Dr. Kane, as amended by the Senate, in the following words:

Resolved, By the Senate and House of Representatives of the United States in Congress assembled,

That the Secretary of the Navy shall cause to be struck and presented to Dr. Kane, his officers and men respectively, such appropriate medals as in the judgment of the said Secretary shall express the high estimation in which Congress holds their respective merits and services.

Approved March 3. 1857.

SENATE, April 2, 1856.

Mr. Mason, of Virginia, from Committee on Foreign Relations reported a joint resolution granting permission to Dr. Kane and his officers to receive from the British Government some expression of their thankfulness for services rendered in connection with the search for Sir John Franklin.

The resolution was supported by Messrs. Cass and Mason, and opposed by Messrs. Crittenden, Bayard and Reid, and modification suggested by Messrs. Seward and Toucey; but went over without action.

SENATE, May 26, 1856.

Mr. Mason of Virginia, called up the resolution authorizing Dr. Kane and the officers associated with him in his arctic expedition, to receive certain presents from the British government, and recommended its passage. After a brief discussion the yeas and nays were ordered, and resulted, yeas 33, nays 4.

HOUSE OF REPRESENTATIVES, Aug. 30, 1856.

Mr. Pennington called up the joint resolution authorizing acceptance of testimonial from the British government, and it was passed without debate.

The following is the text as passed:

WHEREAS, The President of the United States has communicated to Congress a request from the Government of Great Britain that permission should be given by this government allowing Dr. Elisha K. Kane, a Passed-Assistant Surgeon in the navy of the United States, and the officers who were with him in his late expedition to the arctic seas in search of Sir John Franklin, to accept from the government of Great Britain some "token of thankfulness," and as a memorial of the sense entertained by that government of "their arduous and generous service" in that behalf.

Be it therefore resolved by the Senate and House of Representatives of the United States of America in Congress assembled, that Congress hereby consents that Dr. Elisha K. Kane, of the navy of the United States, and such of the officers who were with him in the expedition aforesaid as may yet remain in the service of the United States, may accept from the government of Great Britain such token of the character aforesaid as it may be the pleasure of that government to present to them.

Approved August 30, 1856.

In the Senate, Feb. 24, 1857, Mr. Fish called up the following joint resolution which was passed after a brief discussion of its object:

"The Secretary is hereby authorized to pay to the officers and seamen of the expedition sent in search of Dr. Kane and his companions, while on duty in connection with said expedition, the same rate of compensation that was allowed to the officers and seamen in the expedition under Lt. De Haven; and to such officers as were not mentioned in said expedition, the following additional compensation, namely: The lieutenants and masters, the pay of a lieutenant commanding; the first-assistant engineer, the pay of a chief engineer; and the clerk, the pay of a secretary to commander of a squadron.

This resolution was referred to the committee on naval affairs in the House of Representatives Dec. 7, 1858, and was reported adversely from that committee, January 14, 1859, by Mr. Sherman, of Ohio. It therefore failed to become a law.

The following resolution, approved March 16, 1858, closes the favorable Congressional action in relation to this expedition:

Resolved, That the officers and men engaged in the several expeditions which have been fitted out in the United States for the recovery of Sir John Franklin and his companions be authorized to accept the medals recently transmitted to this government for presentation to them by the government of Great Britain.

The new artesian well which is being bored, under the direction of Mr. Richard, C. E., at Vitoria, Spain, has now reached a depth of nearly 2,200 feet. The diameter of the bore is about 20 inches. The drills are worked by a 32 horse power steam engine. All the machinery is described as being of the most perfect and effective character. It is hoped that one of these days the drills will reach a subterranean river capable of supplying the city with an abundance of the purest water.

CORRESPONDENCE.

SCIENCE LETTER.

PARIS, October 28, 1878.

The ideal of an hospital is, a temporary structure, built for five years, then burned—then replaced. Failing this, the wings of an hospital ought to be well separated, only one or two stories high, and but few patients in a ward. The Algerian section at the Exhibition, shows a model hospital, consisting of 18 wings, 25 yards asunder, only one story high, each ward containing 40 beds. The pavilions ought to be 100 yards apart and the beds less numerous. Air is admitted by ventilators over each bed; the vitiated air escapes by the chimney. Each patient breathes 80 cubic yards of fresh air per hour. Stoves are now banished from all wards, and the air is so distributed, that it will circulate through every nook and cranny of the ward, not like the bed of the river, where the current is strongest in the middle and stagnant at the sides. In Summer when there is no fire in the chimney, a jet of gas is kept burning therein, which thus draws off the vitiated air. In the Menilmontant hospital just opened, M. Ser does not allow the air to enter the wards till it be filtrated and moistened, by passing through cotton, which arrests thus any disease germs. The wards are oval, so that impure air cannot lodge in corners; the walls are varnished, which allow them to be washed, while remaining impermeable, and during the cleansing process, the inmates are changed to another ward. There are distinct wings for small-pox cases, and for the accouchement of women. Athens and Melbourne remind us, they separate persons affected with ophthalmia. Hospital beds ought to have no curtains; the latter serve to store up the seeds of disease or suffocate the patient. Besides wooden shanties, M. Levy exhibits his tent hospitals, as employed by him during the Crimean war, and that the Americans employed so successfully in Paris during the siege. The canvas makes a capital partition, and allows the tent to be adequately heated, even when the external air is several degrees below zero. Holland presents a wagon containing the equipments for a canvas hospital, and 50 quarts of water; it can be installed in an hour, and the air is regulated by a weather cock on the summit. Belgium invites attention to a field hospital, where the india-rubber over-alls of the soldiers constitute the chief material. England and America hold the foremost place with respect to apparatus for moving invalids in beds, chairs, etc.; some of the inventions are works of extraordinary ingenuity. As healing agents, hot and cold water are very efficacious, but must be prudently dealt with, the best plan is to vary the temperature; the warm, correcting the stimulating action of the cold, and inducing nervous reaction. These are the principles only of the Turkish or Roman bath, good for healthy people,

but fatal for those liable to cerebral, lung, and heart affections. There is an instrument exhibited for gargling the throat, and M. Malcz claims, to inject balsamic and mountain air, into sick chambers. However, nothing can replace the light air of mountains and its complement—the exercise, though throat ailments are benefited by respiring an atmosphere impregnated with tar or turpentine; hence the value of a residence in the pine forests of Ardcaebon, near Bordeaux.

The Germans patronize largely baths of compressed and rarefied air. Professor Schnitzler of Vienna, exhibits some curious apparatus under this head; the patient can himself graduate the density of the air: the bath is portable, and affords undoubted relief to the asthmatic, but delicate lungs should take care, as lesions might be produced, and so dangerous bleeding. Recently Dr. Bert recorded a death from the air bath. Artificial gymnastics, walking, measured hill ascensions and singing are safe pulmonary exercises.

Dr. Onimus in 1875, first drew attention to a functional disorder experienced by telegraphic clerks, that they call themselves cramps, similar to what writers and violinists occasionally suffer. The malady is apparently peculiar to the working of the Morse telegraph, and causes a difficulty to co-ordinate the movements which aid to form alternately the dots and lines. The doctor states, the nerve-centers play an important part in this cramp; the cause is not alone to be attributed to the frequent repetition of the same movements, but also to irritability. Having to transmit or receive 7,000 signals per hour, or 49,000 for a total of seven hours work, the clerk not only endures muscular contraction, but much fatigue from excessive tension of the mind. This fatigue is revealed at first, by a contraction in the back of the neck, a phenomenon peculiar to an excess of cerebral attention on the part of those who write much, or largely correct proofs, and known by the feeling of heaviness and uncomfortableness in the posterior part of the head. On experiencing these symptoms all brain work ought to cease, and the sufferer to take a walk, indulge in moderate physical exercise, or seek relaxation in some other mental labor.

It is estimated that the French infantry soldier, owing to the absence of equilibrium in carrying his rifle, expends unnecessarily, an amount of force, equivalent to an addition of two pounds weight to his outfit: he balances the butt by the barrel, whereas the German soldier displays no uneasiness in shouldering his gun. But the step of the German, physiologically regulated in 1864 is different from that of the French soldier. The point may be settled when a decision is come to as to what kind of boot is best for a linesman, and whether flannel or cotton, is better for troops' shirting, as preventive of colds.

M. Bouilland has confirmed his experiments made in 1829, namely, that no organ experiences pain, if the sensitive nerves surrounding it be untouched. Thus, he has been able to prick the hearts, the lungs, and the brain of living animals, without their expressing pain, but the moment the nerve of the coatings was touched, sensation was painfully felt.

M. Bellesme has made the buzzings of insects a life study. It is an error to believe the buzz comes from the wings exclusively. Rēdumur cut off the wings

of a fly and it continued to buzz, but in a sharper key. Take a horse-fly when on the wing, the buzz is grave, an octave; this ceases if the wing be removed. But the sharp sound, never observed when in flight, is now perceptible if the insect be held prisoner; it vi-whizzes rather than struggles, due to the movements of the thorax, and which, vibrating 300 times per second, stir the air in its vicinity, thus producing the sharp buzz. It is owing to these yellow and strong muscles of the thorax being less developed in the butterfly, and the movements thus restricted, that no buzzing noise is perceptible.

No solution has yet been offered respecting the designs upon the slate rocks, in the almost inaccessible valley of Tenede, and that the Minister of Public Instruction has had copied in 1877. The designs are those of oxen and stags, of arms, and of other unknown objects—for the artistic talent is very primitive. The peasants attribute them to the soldiers of Hannibal, which is an effort of the imagination, and some trace a likeness between them and the designs to be found in the Canary islands and Morocco. Scientists are cautious about "explanations," since the Abbè Domenech's misadventure twenty years ago. He went to convert the Red Indians, and found an old copy book full of eccentric signs; concluding he had a "find," he returned to France, and assisted by the Empress, published the *fac simile* of his "Savages' Book." Critics soon discovered it was an old scrap book in Celtic, that amused the tedium of an Irish backwoodsman. Also, M. Reboux has just shown us, that the flint instruments, presumed to have preceded the age of metals, and previous to pre-historic man, are in daily use among Oceanic aboriginals.

M. Paul Bert has made known to the Academy of Sciences, the explanation of certain diurnal motions in plants, of which the sun is cause of their wakening, and its absence, of their sleep. What is the soporific substance at the base of the flower or the leaf, that is the medium of this change? Bert pounded the movable parts of the sensitive plant, and found they contained grape sugar, while the other portion of the stem and leaves had none. The leaflets produce under influence of the sun, the sugar, which lodges in the stalk, and toward evening attracts gradually the water of the stem, and hence, an augmentation of the moving spring, as it were. No sugar is formed during the night, when the sun returns, or light, the tension on the side of the leaflet is diminished, while the opposite side increases in energy; thus movement follows in virtue of the diminished tension in the part exposed to the light.

Lisbon shows at the Exhibition a model of her abattoir, the most perfect of slaughtering establishments in existence, Paris not excepted. Yet the Lisbon butchers opposed the construction of a building, where in addition to supplying primary uses, it prepares the skins, intestines, and tallow of the animals, without the slightest prejudice to health. Tripe is an article of food in much demand among limited purses. It is the inner coating of the stomach; instead of separating it, by continued trampling on the stomach by dirty laborers, it is there obtained by previously steeping the organ in water at 130 degrees, when it readily peels off.

Among the food supplies at the Exhibition must be remarked the excellent collection of bitters, not at all to be despised when prepared from plants; they stimulate jaded appetites, and give a tone to many a patient's stomach. Algeria produces excellent bitters—as well as Holland and Turin; she exports sardines, and also tomatoes in the form of sauce. Sweden and Norway send excellent preserved fish, a food at once light, nutritive, and easily digested, and on which the armies of these countries largely live. The samples of preserved meat by salicilic acid, are superior to those prepared from salt. The conserved fresh meats are more or less good, but opinion would desire that they were excellent. Parisians have made up their minds, that of all the canned food placed on the market, lobster, and next turkey, alone enable themselves to be recognized by their taste when on the table. Liebig's extract has fewer deficiencies than other like substitutes, but lacks many desiderata. Vevey sends a patē steeped in an essence of soup, and salted: it is calculated to render a service during campaigns. The same locality has an excellent food for the old people, and infants about being weaned—a patē formed of toasted bread made from superior flour, mixed with the purest concentrated milk from Norway and Switzerland; for adults there is a powder composed of milk and chocolate. Algeria exhibits excellent honey, which has the great advantage of really coming from the bee.

M. Chancourtois, professor of geology in the Ecole des Mines, has illustrated the formation of the earth's mountain chains and valleys, by the cooling of the mass when in a state of fusion. He represents the earth by an india-rubber balloon, which he places in a bath of melted wax: he inflates the balloon, which in time becomes coated with the melted wax, and destined to represent the molten crust of the earth; the coating of wax on cooling, forms mountains and valleys, resembling very accurately the chains now existing on the globe.

The captive balloon is not so much an amusement, as an important scientific fact. It cubes nearly 28,000 yards, almost the double of the largest balloon ever yet made. It is 160 feet high, or 21 feet less than the *ascenseur* of the Trocadero, it can carry 50 passengers 660 yards high. The difficulty was to find a tissue thoroughly impermeable, as in time gas escapes through ordinary tissue; a special stuff was prepared, consisting of 7 layers, alternately, of muslin, India rubber, and linen, with a coating of drab zinc paint. The boat is a circular balcony, 20 yards in circumference, with a "way" for passengers, three feet wide. The cable can resist a pressure of 25 tons. The gas employed is pure hydrogen. The cable is wound round a drum, worked by machinery, and in the paying out, or taking in, no shock is felt. On ascending no sensation is experienced, save a slight dinning in the ears; the earth seems to descend into a gulf; all objects become lilliputian, and if the sun shines, the shadows of objects fall inversely. Were a sudden gust of wind to break the cable, which is strong enough to resist double the greatest storm pressure of our latitudes, the balloon would not run away farther than the outskirts of the city; there are two escape pipes, one of which is four feet in diameter, and all the apparatus for a speedy descent, under an

experienced aeronaut, is ever ready. The "lifts" at the Trocadero form another kind of ascension; the turrets are 110 yards above the Seine, and the summit of the landing balcony is 69 yards; the piston, corresponding in height, and weighing 20 tons, pushes up a cage sliding between four columnar rails, containing 60 people. The up and down voyage is similar to a mine, only the speed is of the lightning kind. The piston, of course, descends a similar depth into the soil, and is forced upward by a jet of water falling from the summit of the tower underneath it. Shutting off this column of water, with a break in the shape of weights and pulleys, allows the piston and its attached cage to descend. Engines pump the water into a reservoir on the summit of the tower. We are pleased by the view from the turret, but we are astonished and fascinated by that from the balloon.

F. C.

GEOLOGY.

GEOLOGY OF LAGRANGE COUNTY, INDIANA.

BY E. S. EDMUNDS.

To the geologist there is, perhaps, no other state in the Union, between the Mississippi River and the Atlantic Ocean, the Great Lakes and the Gulf of Mexico, that presents so many remarkable phases in geological structure, as our own state of Indiana. In many respects it resembles that of New York, viz: In the north we find the Silurian, the Devonian toward the central portion, and the Carboniferous in the south. In addition to this, we have evidences of the Glacial epoch, which has wrought many wonderful changes in many portions of the state, as will be seen by Prof. Collet's report* of Owen county, which is as follows: "From the northwestern corner of the county to the southeastern, a broad belt of from six to ten miles wide, embraces a hilly, almost mountainous, region, in which high hills and deep valleys alternate in close succession. It presents many extensive views full of wild and picturesque beauty. From a point on the divide, some distance northeast of Patricksburg, an illusion having an important bearing on the past geologic history of the county was noticed. Thence the surface of the elevated area and ridge-tops sloped gently to every point of the compass. The deep ravines were hidden by the wall-like ridges with their mantles of tree and bush, leaving no hint of the profound valleys one hundred and eighty to two hundred and fifty feet deep, which largely occupy this area. From that standpoint was revealed the ancient rocky surface of the county, as it came from the hand of nature, modeled in the bosom of the ocean, a great plain sloping

* Geological Survey of Indiana, 1875.—E. T. Cox.

gently to the west, northwest and southwest, before the currents of ice-water, in the glacial age, demanding egress to the south, had eroded their deep valleys."

Recollecting the fact,* mentioned in the foregoing general description, that the original surface presentation of this county, as it emerged from the mother carboniferous ocean, was a great plain, sloping gently to the west, with two slight ridges guarding to the north and south, the depression or gulf-like basin, three or four miles wide, about and west of Patricksburg, in which the block coals were prepared and deposited, the question naturally occurs, to what causes may the well-developed system of hills and valleys be attributed.

There is no evidence of volcanic energy; little, or none, of earthquake action, except the slow, gentle oscillation, by which the crust of the earth is continuously raised or depressed over large areas continently. Close observation will at once discover agencies, in the long past, of adequate power. The elements are nature's great agents—water, air and heat: ice, her great plow; water her graver; and air and heat her moulder. With them and time, she has accomplished the denudation and erosion of mountain, plain and valley. We have but little knowledge of the long period which followed the emergence of this region, till the Glacial age. We know that it was long enough for the Permiassic, Triassic, Jurassic, Cretaceous and Tertiary seas, in the great valley of the continent to the west, to develop and sustain their wondrous life under a tropical clime. This was followed by a period of intense cold, which has left many records of existence, graven with a pen of ice, "*on the rocks forever.*"

The glacial epoch on our continent is divided into two periods,—the first, in which a deep, massive river of solid ice flowed up the St. Lawrence valley, plowed out the beds of Lakes Ontario and Erie, resting its ice foot along a ridge still seen in Northern Ohio and Northeastern Indiana, and discharging a flood of ice-water, melted by the warmth of each recurring summer's sun, by sluice-ways (present river valleys) into the Ohio and Wabash rivers. At Put-in-Bay and Kelly's islands, vast surfaces are planed off as smooth as a floor, others grooved and striated, each mark indexing the course and initial point of the mighty ice machine, and recording a mysterious chapter of the book of nature. The general course of this flood was along the axis of these two lakes, and an average of the observations made was that its direction was south 80° west. Of this period, we have only fragmentary evidences in this state. Of the second glacial period, the evidence is apparent to the *careless* observer. The records are easily read. It was subsequent to the St. Lawrence flow, for on the Bay Islands, the southern shore of Lake Erie and wherever else observed, its striæ override and its debris obliterates the marks and channels of the latter. It came from the extreme north, loaded with Arctic granites. Crossing Lake Superior, it took up iron-ore-copper, queenstone and pudding stones from Keneenaw Point and the Manitou, line Islands. Divided by the peninsula of Michigan, the larger stream flowed solidly up Lake Michigan, hewing out its bed, and thence, pushed by congela-

* Ibid.

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tion in the rear or drawn by the ice vacuum in front, poured its rigid current over the northern half of Indiana and Illinois. Probably of extreme thickness at the north, the ice sheet did not have a height of over two hundred to four hundred feet in Central Indiana, as measured by the Glaciometer."*

That the northern portion of our state has been covered, at some period, by a vast sheet of ice, there cannot be a shadow of a doubt. To some, who are skeptics regarding the great and sublime truths of geology, this may seem almost impossible. But here are the proofs, written as with legible characters, and graven upon the very rocks themselves. The track of the tornado is strewn with the debris that was scattered during a fearful and devastating period, short, but terrible in its effects upon human life and the habitations of men.

The glaciers, as has been shown by Agassiz and others, move quite slowly, but, in the course of their passage, collect great quantities of rock and other detached portions of matter, and deposit them, in many cases, at a great distance from their starting-point. The path of a glacier may be known by the grooves cut in the solid and almost unyielding rock. Often the rocks are found planed off as smoothly as if done with a plane; there are evidences of the "graver." Then, from these facts, we conclude that these deposits of sand, gravel and boulders were brought from the icy regions of the North, and deposited as known glaciers deposit their contents—by the melting of their substance. With these remarks for an introduction, I now begin my subject proper.

The geographical situation of LaGrange county is as follows: It lies between 41° 30′ and 41° 45′ north latitude, 85° 15′ and 85° 40′ west longitude. It is bounded on the north by St. Joseph county, Michigan; east by Steuben county, Indiana; south by Noble county, and west by Elkhart county. It covers an area of three hundred and eighty-four square miles, or two hundred and forty-five thousand seven hundred and sixty acres. The county seat is LaGrange, a thriving town of about two thousand inhabitants. Like many of the northern counties of Indiana, this county is dotted with numerous lakes, which add much to the beauty of the landscape, beside exerting marked changes in the climate and healthfulness of the county. These climatic phases, however, are not without their exceptions, as we shall see in the future.

Nearly two-thirds of the county is beautiful prairie, which is named in its different portions, according to different historical or natural data. For instance, one division, situated in the northeastern part, is called "English Prairie," from its having been settled by a colony of English emigrants; another is named "Mongoquinong Prairie," after a tribe of Indians of the same name; the third division is called "Pretty Prairie" because "dame Nature" bestowed her favors so lavishly upon it. As is the case with most prairies, they are all nearly level. The remainder of the county is rolling and covered with numerous swamps and marshes, which, while they are the source of much malaria, afford excellent pasturage. There is only one large stream that flows through the county, and, while it is small for a river, is too large to be called a creek. It received the

* Ind. Rep., 1874, fol. 82.

name of White Pigeon River, nearly half a century since, from an Indian chief, who was buried at a small village in Michigan, which was named after him also.

On the prairies, the soil is a dark, sandy loam; and in many instances, is nearly black. There is, however, but a small per cent. of sand; in most places this renders plowing very difficult, except with the most highly polished steel plows. The soil upon the openings is much lighter colored, and contains much sand and gravel. This soil requires high manuring and a limited amount of cropping to keep it up in good condition. On the other hand, the prairie soil is very productive, to a great extent, owing to the rich deposits and strata of alluvium that have been bountifully deposited over the surface during the recent geologic period. The low swamps and marshes are very productive after underdraining; this soil is well adapted to most of the cereals and furnishes a good quality of *humus* so necessary for plant-life. Good water is obtained at an average depth of about forty feet. It is generally impregnated with lime, magnesia, iron, sulphur, and occasionally with sodium. The highest land of LaGrange county is about *seven hundred feet* above the level of the sea. The lowest cannot be more than one hundred feet less, and, as we have no mountains and lakes, situation and air currents mostly govern our climate. Like other portions of this country, the climate is subject to extremes of heat and cold; and, in such a degree, that only two or three hours are required to effect a change of several degrees in the thermometer. Owing to the number of marshes, much *malarial* matter is thrown off, causing a great amount of ague, bilious and other fevers. This does not, however, extend to the highland, as a rule, but is confined to the low, marshy districts. Meteorologists tell us that there is a belt of country south of the "Great Lakes," extending nearly one hundred miles, with a uniform breadth of about forty miles. Over this area of nearly *four thousand* square miles, during the warmer portions of the year, the atmosphere is heavily charged with malaria, which creeps into the human system, causing fevers and ague in abundance. But, notwithstanding these unhealthy phases of its climate, it is regarded as a very fine country.

LaGrange county lies wholly within the Boulder Drift, or Quaternary epoch, except the extreme northwestern portion, which is a modification of the above epoch. In the central and western portions of Van Buren township, traces of the Silurian and Devonian periods are found. In the drift, we find, in this locality, evidences of powerful upheavals, which have brought the rocks of those early epochs up to the clear sunlight, and, by their fossiliferous appearance, we can read them; obtaining, as from the leaves of a book, a knowledge of the animal life of those periods. Owing to the thickness of the Boulder Drift, which is, perhaps, upward of a hundred feet, it is rather difficult to determine the thickness of each strata. In boring wells, in this and other counties around us, a distance of from eighty to two hundred and twelve feet was passed through before reaching the underlying rocks of the Devonian age. From what I have seen, and from the statements of well-diggers and those engaged in boring for water, I have learned that the clay formation is most predominant; with a little

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sand and clay on the top, interspersed with now and then a boulder. This develops the fact that the great bulk of the recent formation is clay. This clay near the gravel, is often very compact, and it is then called hard-pan. Sometimes, in boring for water, the auger strikes a large boulder; in such cases the auger must be withdrawn and another trial made in a new locality. Generally after going through the hard pan, water is found in the layer of sand below. The outcropping of the Silurian and Devonian epochs, as I remarked before, shows conclusively that a tremendous upheaval must have occurred to bring the old series of rocks to the surface; and other phenomena connected with the formation; there was most certainly a *powerful volcanic action*. That the Silurian and Devonian seas are strongly marked in this section there can be no question. One has only to take a little pains to gather up the leaves of the book, and it can be read, as a history, full of grand and interesting thoughts.

I said that evidences of the above epochs are abundant, and, to prove my position, I will name the fossils in the order of their periods, using the classification of Prof. Dana in his Manual of Geology. I shall consider, in this article, that the reader is somewhat familiar with the origin of the names of the different periods so that a rational idea of the subject may be obtained.

LOWER SILURIAN.—In the Primordial or Cambrian period we first find the Acadian epoch, consisting of conglomerate and slate; this is not, however, found in any considerable quantities. I have seen some very fine specimens of conglomerate (pudding stone), and have in my possession specimens containing stones of many different colors. Now, whether this conglomerate was upheaved, or brought during the *drift-period* I am not able to decide.

POTSDAM EPOCH.—The rocks of this epoch are evidently of sea-shore origin, and, in most cases, marked with ripples. Through their substance the tracks and boring of worms can be distinctly traced. In my cabinet, I have a piece of the rock, which not only shows the holes eaten by the worms, but the minature eggs, requiring the microscope to reveal them, are as plainly to be seen as though they had been deposited there but yesterday. From the size of the borings, these worms were probably something near the form of our common "angle worm" of to-day. Different phases of the rock appear, in which they bear the marks of "rain-pits." As though, while lying upon the beach, a heavy rain had fallen, and the largest drops had left their imprint in the soft mud that lay upon the shores of those early Silurian seas. In the language of Dana, "The Primordia rocks have afforded evidence only of marine life." In the classification of the animals of this epoch, "the species observed are all intervertebrates; they pertain to the four sub-kingdoms—PROTOZOANS, RADIATES, MOLLUSKS and ARTICULATES." Of the Radiates, perhaps the Brachiopoids are the most abundant fossils of the Silurian.

FAMILIES.—Those most abundant in this section are the Spirifer, Orthis and Lingula.

GENERA.—*Spirifer striatus, Calceola sandalina, Siphono treta* of the Spirifer family. *Strophomena planumbona* and *Orthis striatula* of the Orthis family. Of

the Lingula family the *Obolus Appollonis*, *Lingula Matthewi* and *Discina Acadia* with a number of species of the *Trilobite* are found. Passing to the next epoch, which is the

CHAZY—We find numerous species of coral, among which the *Retepora incepta* and *Ptelodictya fenestrata* are the most predominant. Some imperfect specimens of the *Maclurea magna* and *Scalites angulatus* are met with occasionally together with other fossils of this epoch.

TRENTON EPOCH.—This, the last but two of the Lower Silurian, figures very extensively in the geology of Van Buren township. The seas of this epoch were densely populated with animal life. That this is true, I think the testimony of the rocks shows most unequivocal evidence. Even in this region I find the representatives of nearly all the sub-kingdoms. Among the Radiates, corals of various kinds abound, prominent among which are the *Petrai corniculum* and *Columnaria alveolata*. Of the class of *Polyps*, as well as *Crinoids*, the *Graptolithus amplexicaulis*, *Chætetes lycoperdon*, are numerous. The Brachiopod family represented are the *Orthis lynx*, *Orthis occidentalis* and *Orthis testudinaria*; the latter are very numerous. Of the *Gastropods*, the *Murchisonia bellicincta* and *Pleurotomaria lenticularis*, to which is added the *Cephalopods*, *Orthoceras junceum*, *O. vertebrale*, *Ormoceras tenuifilum*, *Cyrtoceras annulatum*, *Cryptoceras nudatum* and *Trocholites Ammonius*.

Of the CRUSTACEANS, the Trilobite family is well represented: *Asaphus gigas*, *Calymene Blumenbachii*, *Lichas Trenotensis*, *Agnastus bobatus* are the most abundant.

UTICA AND CINCINNATI EPOCHS.—Among the fossils of these epochs we notice those most numerous: *Favistella stelata*, *Halcysites gracilis*, *Syringopora obsoleta* and *Tetradium fibrosum* of the *Radiates*; *Ambonychia radiata*, *Modiolopsis modiolaris* and *Orthonota parallela* of the Mollusca. The Articulates are represented mostly by the Trilobite family, among which are the *Asaphus platycephalus*, *Calymene blumenbachii* and *Trinucleus concentricus*.

According to Dana, the whole thickness of the Lower Silurian Period, over this section of our state is about seven hundred feet, or about the same as that of the state of Illinois. Leaving the above period, we ascend to the

UPPER SILURIAN AGE.—In which we find "Marine life, large oceans, &c." These features continued to characterize this period as they did the Lower Silurian. In the Niagara Period occurs, in naturnal order, the Medina Epoch, which is not worthy of mention; but the Clinton and Niagara epochs reveal their history most gloriously. The outcroppings of the latter produce great quantities of lime in some portions of the state, while here only the characteristic fossils are to be seen; these consist of the following animals: *Arthrophycus Harlani*, *Linguella cuneata*, *Modiolopsis orthonota*. The following represent fossils of the Clinton group: *Zaphrentis bilateralis*, *Palæocyclus rotuloides* and *Chætetes*. The first is commonly known as the "cup-coral" and resembles in form, exteriorly, the end of a cow's horn, broken or cut off.

In the Niagara group, those most common are: *Conophyllum Niagarense*,

otherwise known as the "cup-coral," *Favosites Niagarensis*, which is a columnar coral so named from *favus*, a honey-comb, which it strongly resembles, *Halysites catentulata*, or chain-coral, and *Heliolites spinipora*. Many fine specimens of the *Favosites* and *Halysites* can be picked up in the fields where they have lain for ages; scarcely dimmed by their exposure to the elements; they lie with their bright faces upturned, seeming to say, "study me and I will relate a truth to you that you will not find elsewhere." The fossils of this group, to the geologist, are of the most interesting character. When placed under a powerful magnifier, they reveal cells of the most complicated structure, the sides of which are as symmetrical as the cells of the honey-comb. To see these cells filled with a formation as hard as crystal, and with such regularity, having been upheaved by igneous or volcanic action, and having lain for countless ages, now coming to the light of intelligence, the mind is filled with grandeur and sublimity. Niagara, with all its power and glory, can scarce awaken a stronger series of emotions in the heart of the geologist and lover of nature, than the numerous inhabitants of those early periods of this planet's existence.

DEVONIAN AGE:—Occasional traces of the Flora of this age are found, among which are the Conifer species of the earliest known genus of the family Prototaxites. Of the Fern family, the caulopteris antiqua is represented. These undoubtedly were chief among the trees of the Devonian forests.

ANIMALS.—Chief among the fossils of the Fauna of this age, are the following: Zaphrentis gigantea, Zaphrentis Rafinesquii, Phillipsastrea Verneuili and Favosites Goldfussi. I have not found any fish, although this is the age of fishes. They have been found in the southwestern portion of Indiana, and in some parts of Ohio; but as yet, I have not been able to find any in this locality. Passing along upward we leave the Devonian, and reach the

CARBONIFEROUS AGE.—In the southern part of Indiana, this is well represented in the extensive coal fields which abound there. We have no coal, that is brought to the surface at least. But in the Sub-Carboniferous Period, we have several fossils, among the most predominant, the Spirifernia octoplicata and Spirifer bisulcatus, are found. Geodes of the Keokuk group are occasionally met with. Some of these are very fine specimens. They are not as large, however, as are found in some sections of the country, particularly Missouri. Before leaving the Carboniferous age, I will quote from Prof. Steele: "A fearful earth storm swept over the continent; not only twisting and dislocating the horizontal coal-beds, but lifted them above their former level. An evolution of the internal heat accompanied the convulsion; and thus the bituminous coal was metamorphored into anthracite. This effect, like that seen in the rock strata, was most felt near the Atlantic coast; hence we find anthracite coal in the Appalachian mountains, next semi-bituminous, and in the western era, bituminous coal alone." To give the reader an idea of the extent of our western coal fields, in comparison with those of other portions of the United States, and also of foreign countries, I append a statistical account of the "coal area:"

The Appalachian coal field	80,000	square miles.
Indiana, Illinois and Kentucky	50,000	" "
Iowa and Missouri	60,000	" "
The Michigan	15,000	" "
The Great Britain	12,000	" "
Continent of Europe	10,000	" "
Nova Scotia and New Brunswick	7,000	" "
United States more than	200,000	" "

Prof. H. D. Rogers states, approximately, the amount of coal in the most important coal-fields in the world, as follows:

Belgium	36,000,000,000	tons.
France	59,000,000,000	"
British Isles	190,000,000,000	"
Pennsylvania	316,400,000,000	"
Appalachian	1,277,500,000,000	"
Indiana, Illinois and Kentucky	1,277,500,000,000	"
Iowa, Missouri and Arkansas	739,000,000,000	"
Total amount in North America	4,000,000,000,000	"

It will be seen that Indiana, Illinois and Kentucky, in their geological formation, contain not much less than the Appalachian coal-fields. This speaks well for our fuel in the future. "In some parts of the world they are beginning to calculate how long their supplies of coal will last. In England not less than 6,000,000 tons of coal are yearly raised from the mines of Northumberland and Durham; at which rate they will be exhausted in about 250 years. In South Wales, however, is a coal-field of 1,200 square miles, with 23 beds, whose total thickness is 95 feet; this will supply coal for 2,000 more. Here, in North America, we have 21 times as much coal as Great Britain. Estimating our annual consumption of coal at twelve million of tons, there is coal enough in North America to last three hundred and thirty-three thousand three hundred and thirty-three years." It is estimated, approximately, that the annual consumption of coal in the whole world is one hundred millions of tons. With such prospects for fuel, we need not be alarmed that wood is becoming scarce, for there is enough fuel and to spare, under the ground; it only needs the application of man's inventive powers to bring it to the surface, and it is ready for use, without much further trouble.

I have already drawn my descriptions to a much greater length than I intended; for which, I hope my readers will pardon me. In my next article I will endeavor to present the features of the succeeding periods as they were developed; closing with a description of the recent period, giving the "Fauna and Flora," minerals, &c. I have been prompted to write for the purpose of satisfying myself concerning a matter over which a strange mystery broods. In correspondence with the Assistant State Geologist, on the geology of Lagrange county, he says: "If any wells in your vicinity have been lowered to the rock, please inform me what formation was passed through, as I would like to ascertain

more definitely regarding the formation." In speaking of the fossils of Van Buren township, I said that it was volcanic action that brought these remains of Silurian and Devonian seas to the surface (?) and that is my opinion now, notwithstanding professors, principals of schools, etc., claim that they were brought in and through the agency of the drift period. Will our geological readers assist me in solving the problem, and in so doing confer a favor on an investigator and lover of Geology ?

SCIENTIFIC MISCELLANY.

PROFESSOR MORTON ON THE ELECTRIC LIGHT.

In a lecture before a meeting of the American Gas Light Association, at Stevens Institute, Hoboken, October 17, Professor Morton reviewed the progress made in producing light by electricity, and discussed at some length the question of competition between electricity and gas. In tracing the history of the electric light he said that it is, as applied to practical purposes, essentially a phenomenon of magneto-electricity, or the mechanical production of electricity, because electricity produced by the battery is only used as a matter of scientific interest. In this sense the possibilities of the usefulness of the electric light originated with Faraday's discovery of magneto-electricity in 1831, as everybody knows. This was followed within a year or two by the invention and construction of magneto-electric machines by Saxton, Clark and others, and these were developed in size and power by Holmes, and by the various inventors whose work is embodied in the machine known as that of the Alliance Company, in Paris, a machine capable of producing a very brilliant electric light, but very bulky and very expensive, requiring immense power to drive it. Its use was consequently limited to the Falmouth lighthouse, in England, and to some French lighthouses and works of construction like the Cherbourg docks.

The first decided improvement upon this machine was made by Siemens, who devised a peculiar form of armature. The next step forward was made by Mr. Wild, of England, who made the remarkable discovery that if a current from a small magneto-electrical machine was made to pass around the coils of a large magnet, the attractive power of that magnet would be immensely greater than the force of the magnets in a small machine. Thus by working a small machine, passing the currents through electro-magnets of a large one, and then taking from the armature of the large machine the current to be used, he obtained great electric power in a small compass. Almost at the same time Wheatstone and Siemens made similar improvements, and a machine, between them and Ladd, of London, received another development by having this curious combination introduced. A single set of electro-magnets were employed, with an armature between

the poles wound with two coils, one coil being so connected as to pass the current through the electro-magnet itself, and the other supplying a current for exterior use. In this way the machine, as it were, excited itself, and then yielded a powerful current for exterior work.

In all the machines used, up to this time, the armature had its magnetism reversed as it rotated, and this involved a great loss and waste of power. The French cabinet-maker, Gramme, conceived the idea of using a ring and rotating this ring between the poles of a magnet in such a way that there should be no reversal of poles, but merely the traveling of the poles around in the ring. This ring was surrounded with poles from which the induced current was taken. The idea here involved was so unpromising that several electricians wrote very decidedly concerning it, opposing and ridiculing it. Nevertheless it produced in practice a machine which possessed a remarkable merit in yielding a large quantity of electricity with a very small expenditure of power. In this country, Mr. Palmer, of Boston; Mr. Wallace, of Ansonia; Mr. Brush, of Cincinnati; Mr. Weston, of Newark; and Mr. Hockhausen, of New York, have all developed machines which involve some of the general principles contained in the earlier productions, and all of which are excellent in their way. By one or other of these machines we are now enabled to produce light by an expenditure of power so small as to render its production cheap; probably not far from a fair average is that of 1,000 candles per horse power. Consequently this light has opened to it a wide field of usefulness and practical application which did not exist when it was more expensive.

Touching the practical uses of the electric light, Professor Morton said that the illuminating of large workshops, of public buildings, places of amusement, gardens, and the like, is undoubtedly an accomplished fact, and this use of the electric light, we feel confident, will largely extend. But it has been suggested that more than this will soon be reached, and that the electric light will take the place of other sources of illumination, gas, for example, in private houses. It would be very foolish for any one to attempt to predict what may or may not be accomplished in the future, but in such a case as this we may at least look back at the past and see what has been the history of the same thing, and judge something of future probabilities from past experiences.

Thereupon the speaker described at length the unfulfilled promises of Mr. Jobart's method of dividing the electric light, which twenty years ago was thought to have solved the great problem of electric lighting. He would by no means have it inferred that better success could never be attained. On the contrary, there are several very promising directions for experiment, on one of which, no doubt, Mr. Edison is at present embarked; but the difference between a promising line of experiment and a successful result all the world's history teaches us, is often a distance of many years, to say the least.

The method of producing light by heating a platinum wire by the electric current was then exhibited and explained, and its difficulties enlarged upon. Also the production of light in Geissler tubes, and by the extra current as em-

ployed by Professors Houston and Thomson, of Philadelphia, in which direction he thought something might be attained. Of the speedy substitution of the electric light for the gas light, Professor Morton was very skeptical; no such radical change as many expect, need be expected this century.

An interesting feature of this lecture was the exhibition of an improved gas burner giving a light of 250 candles with the consumption of forty cubic feet of gas an hour.—*Scien. Amer.*

THE MOST ANCIENT LAND SURVEY IN THE WORLD.

Discoveries recently made at the British Museum among the cuneiform inscriptions on the terra-cotta tablets of ancient Babylon render it questionable whether the Babylonians should not have at least equal credit with the Egyptians for the discovery of the science of geometry, and of its application to land-surveying and the delineation of lands.

The number of documents (that is, terra cotta tablets) which the Museum now possesses in relation to the commercial and land transaction of ancient Babylon and Assyria is very great, a collection of more than 2,000 having been purchased at Bagdad in 1875.

There are many interesting facts as to the daily life of the ancient people to be gathered from them, but that which it is our present purpose only to notice is the tablet which contains, not simply a description, but an actual *plan* of the land referred to in the document, just as plans are now drawn on parchment in the margin of leases. This, we think we may safely say, is at present the oldest known land-survey in the world. It is drawn on a tablet in dark terra cotta, about 6 inches by 3¼ inches and represents a plot of land about 8½ acres in area. The inscription at the top informs us that it is the plan of "A field in the high road on the banks of the river or canal," Nahr Banituv. The name of the river, however, is obliterated, and its place has been supplied by Mr. Boscawen from information drawn from other tablets relating to adjoining property. The estate is divided into three pairs of parallelograms, to which are added two more similar-shaped plots, and an irregular trapezoidal piece. The dimensions are all given in cubits, or fractions of cubits, most carefully figured on the drawing. Taking the Babylonian cubit as 20.475 English inches, the greatest length of the estate would be, from north to south, 1,646 cubits, or 936 yards 0 feet 5 inches English. The width on the northern border on the edge of the highway is 84 cubits=140 feet. The dimensions on the southern part being much defaced, it is difficult to ascertain the length of the base line. On the east side the curve is most carefully measured, its circumference being 120 cubits, or 200 feet. A small dimension has been marked in the interior of the arc, which evidently represented its radius, but it is unfortunately obliterated. The northern boundary is the highway, or, as it is called in another document, "the royal highway." (It is interesting to notice such a very ancient use of our present common phrase,

"the king's highway.") The western side adjoins the lands of Ipriya and Buruga, the son of Taria, the son of the Chief Builder, and this latter person is the owner also of the land on the southern boundary. The eastern side and the upper portion adjoin the lands of Nabusar-ibni, and another portion adjoins the lands of Kasiya, the son of Dibzir, the son of Pitu-sar-babi. It would seem strange for a modern surveyor to mark upon his plan, not only the names of his client's neighbors, but those of his fathers and grandfathers, yet this practice has revealed to us the fact that the ancient Babylonian "Chief Builder," or architect, was a person of some consequence, who left lands behind him, and grandchildren to be proud of their descent from him; and not the serf, or servant, which he was mistakenly represented to be in one famous modern picture.

As an example of the system of mensuration, and curious method of computation of the area, which was according to the amount of corn seed required to sow it, we make the following extract from a tablet dated in the third year of Nabonidus, king of Babylon:

1. 949 cubits on the upper side toward the west a boundary is fixed.
2. By [the land of] Nabu-sum-utsir, the giver of the field.
3. 949 cubits on the lower side toward the east the boundary is fixed by the land of Nabu-sar-ibni, son of Marducu.
4. 40 cubits the upper headland, a boundary line is fixed by the king's highway on the bank of the canal of Banituv.
5. 40 cubits the upper headland, a boundary is fixed by the other portion of the field.
6. For this field, and this portion, five measures of corn seed. A field with the wells attached
7. A valuation of 5 epha., 8 measures of corn seed.
   This is the first measurement.

This represents the measurement and sowing area of the first portion of the land sold in the tablet. A second portion which joins on to the southern border, is also computed by a similar arrangement. A summary of the two results is given, and the price in silver, according to the market value of corn, is computed and entered as the price of the land. A guarantee of about one-tenth per cent. is required and given as security for the fulfillment of the clauses of the deed. The names of seven witnesses who attest the deed, by affixing their *nail-marks*, and the scribes, who append their seals, testify to the legal character of the document.

Such was the legal procedure in the conveyance of land 2,500 years ago in ancient Babylonia. How little it differs from the legal acts and deeds which are daily transacted in our modern Babylon of London and in this Great Britain which has just assumed new responsibilities in relation to the old country whence these antiquities have been exhumed!—*Building News.*

MOULD IN CELLARS.—A German agricultural journal gives the following: Put some roll brimstone into a pan and set fire to it; close the doors, making the cellar as nearly air-tight as possible for two or three hours, when the fungi will be destroyed and the mould dried up. Repeat this simple and inexpensive operation every two or three months, and you will have your cellar free from all parasitical growth.—*Boston Journal of Chemistry.*

EYES OF FLOUNDERS.

How the eyes of the flounder become situated both on the same side of the head is discussed by Mr. Agassiz in the Proceedings of the American Academy of Arts and Sciences. The young flounder immediately after hatching does not differ from other fishes, but very early in life, as is seen in eight species, one eye begins to pass, by a combined process of translation and rotation, over the frontal bones from the pale side to the dark side. In *Plagusia*, however, the eye sinks into the head, the old orbit closes up as the eye works its way across the head of the *Plagusia*, until eventually the right eye gets entirely over to the left side. Pouchet has recently called attention to the fact that the want of color on the blind side of flounders is plainly due to the partial atrophy of the great sympathetic nerve, effected during the passage of the eye from one side of the head to the other.—EDITOR'S SCIENTIFIC RECORD, in *Harper's Magazine for October.*

SIMPLE TESTS OF WATER.

The complete analysis of potable water requires much chemical skill, but the more common impurities may be detected by comparatively simple tests. Certain deleterious salts may thus be recognized. Among these are the nitrates, whose presence is chiefly significant as showing that organic matter has been acted upon and *may be present.* The danger is not in the salts themselves but in their source, which should, if possible, be ascertained. To examine water for nitrates, put a small quantity of it in a test tube; add an equal quantity of pure sulphuric acid, using care so that the fluids shall not mix; to this add carefully a few drops of a saturated solution of sulphate of iron. The stratum where the two fluids meet will, if nitric acid be present, show a purple, afterwards a brown color. If the nitric acid be in minute quantities, a reddish color will result. The presence of ammonia, if in excess, can be determined by treating the water with a small quantity of potassic hydrate. Ammonia, if present, will be liberated and may be recognized by its odor, or by the white fumes of chloride of ammonium when a glass rod wet with muriatic acid is passed over the mouth of the test tube. If chlorine is present in any form in water used for drinking, it is evidence that sewage contamination in some form exists. The presence and amount of chlorine may be ascertained by the following simple method: Take 9 grains of nitrate of silver, chemically pure, and dissolve it in 200 units (say, cubic centimetres) of distilled water. One unit of the solution will represent 1–100th of a grain of chlorine. Take a small measured quantity of water to be examined, and put into a glass vessel more than large enough to hold it. Add to the water a *small* quantity of the solution; if chlorine be present, a white precipitate will result. Repeat the addition, after short intervals, until no precipitate results. The units of the solution used will determine the hundredths of a grain of chlorine present. If more than a grain of chlorine in a gallon be present, reject the water, unless it can be clearly determined that the excess does not come from sewage. The water should be slightly acidulated with nitric acid before the test is applied.

Several years ago we described and commended Heisch's sugar test for the presence of dangerous organic matter, but it is worth repeating in this connection, being at once simple and trustworthy. Place a quantity of the water in a clean, glass-stoppered bottle; add a few grains of pure sugar and expose to the light in a window of a warm room. If the water becomes turbid even after exposure for a week, reject it; if it remains clear it is safe.—*Boston Journal of Chemistry.*

A STORY OF SCIENCE.

BY ONE WHO KNOWS NOTHING ABOUT IT.

A philosopher sat in his easy chair,
Looking as grave as Milton;
He wore a solemn and mystic air
As he Canada balsam spilt on
A strip of glass, as a slide to prepare
For a mite taken out of his Stilton.

He took his microscope out of his case,
And settled the focus rightly:
The light thrown back from the mirror's face
Came glimmering upward brightly.
He put the slide with the mite in place,
And fixed on the cover tightly.

He turned the instrument up and down,
Till getting a proper sight, he
Exclaimed—as he gazed with a puzzled frown—
"Good gracious!" and "Highty-tighty!
The sight is enough to alarm the town—
A mite is a monster mighty!"

From t'other end of the tube, the mite
Regarded our scientific,—
To its naked eye, as you'll guess, the sight
Of a man was most terrific,
But reversing the microscope, made him quite
The opposite of magnific.

"One sees the truth through this tube so tall,"
Said the mite as he squinted through it,
"Man is not so wondrously big after all,
If the mite-world only knew it!"

MORAL.

MEM.—Whether a thing is large or small
Depends on the way you view it!

Fun.

EDITORIAL NOTES.

THE articles in this number by Rev. James French and Dr. Heath, were read at recent meetings of the Kansas City Academy of Science, while that by Prof. F. H. Snow was read before the Kansas State Academy of Science at Topeka last month.

DR. HEATH has returned to Peru, and it is a pleasure to be able to state that he will, from time to time, contribute articles to the REVIEW from that interesting country.

PROF. WARD, of Rochester, made us a brief call on the 9th inst. He is visiting the West in search of Archæological specimens for his Museum.

SIR WYVILLE THOMSON has divided out the labor of working up the collections made by the *Challenger* Expedition, without regard to the nationality of the naturalists selected, and has been fortunate enough to secure the assistance, in this country, of Professors Alexander Agassiz and Theodore Lyman, in elaborating the *Radiates*, the former having charge of the *Echinidæ*, and the latter of the *Ophiuridæ* and the *Astrophytidæ*. This action has brought forth some criticism, but Sir Wyville contends that his duty requires of him to furnish the best possible reports on the various subject of inquiry, and that science knows no nationality.

NEW EXCHANGES.—Since our last issue we have been favored with the following new exchanges, viz: *The American Quarterly Microscopical Journal*, a very handsome octavo of 82 pages, edited by Prof. Romyn Hitchcock, fully illustrated, published by Hitchcock & Wall, New York, at $3.00 per annum; *The Science News*, published fortnightly by S. E. Cassino, Salem, Mass. It is devoted especially to "the prompt publication of scientific news," and is edited by Ernest Ingersoll and Wm. C. Wyckoff, of New York. 16 pp. octavo, $2.00 per annum; *The University Courier*, published monthly by an organization of students of the Kansas University at Lawrence, Kansas, edited by H. C. Burnett, assisted by several young ladies and gentlemen, among whom we notice the name of R. W. E. Twitchell, of this city. The first number presents a very fine appearance, and contains much valuable matter. Price, 50c per school year. *The American Young Folks*, edited and published by Hudson & Ewing, Topeka, Kansas. This is a well established, first class, youth's paper, well deserving the patronage of the young folks of the West. 16 pp. folio. 50c per annum.

H. W. BACHE, of the United States coast survey, died in Bristol on the 7th inst.

SIDNEY J. HARE, one of our students, has presented a neat case of geological specimens, representing all the strata found in Kansas City from No. 78 to No. 100 of Broadhead's geological survey, for the permanent use of the Central school of this city; accompanying it is an explanatory diagram, both of which are invaluable to the natural science department. On motion of Mr. Switzer, a vote of thanks was extended, by the Board of Education, to Mr. Hare for his excellent donation.

IN the hope of gaining a few more subscribers, we make the following offer: To all who will subscribe for the current (Second) volume, beginning with the April, 1878, number, we will give the whole of the First volume for the nominal sum of ONE DOLLAR, thus making the two volumes, amounting to over 1500 pages, $3.50. This is an excellent opportunity to obtain two voumes of fresh, first-class, popular science at a low price.